020806/P

RECORD OF DECISION
FOR
OPERABLE UNIT 9
BASEWIDE GROUNDWATER

SDMS DocID 296836

NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command
Mid-Atlantic
9742 Maryland Avenue
Norfolk, Virginia 23511-3095

Submitted by:
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CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 431

SEPTEMBER 2008

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LIST OF ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
AS/SVE	Air sparging/soil vapor extraction
AST	Above-ground storage tank
Atlantic	Atlantic Environmental Services, Inc.
B&RE	Brown & Root Environmental
BGOURI	Basewide Groundwater Operable Unit Remedial Investigation
bgs	Below ground surface
CB	Chlorobenzene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Act Information System
CFR	Code of Federal Regulations
CGS	Connecticut General Statutes
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Chemical of concern
COPC	Chemical of potential concern
CTDEP	Connecticut Department of Environmental Protection
CTE	Central tendency exposure
DCB	Dichlorobenzene
DDD	1,1-Dichloro-2,2-bis(4-chlorophenyl)ethane
DDT	1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane
DGI	Data Gap Investigation
DRMO	Defense Reutilization and Marketing Office
EEQ	Ecological effects quotient
Envirodyne	Envirodyne Engineers, Inc.
EPA	United States Environmental Protection Agency
ERA	Ecological risk assessment
ESQD	Explosive Safety Quantity Distance
FFA	Federal Facility Agreement
FFS	Focused Feasibility Study
FS	Feasibility Study
FWEC	Foster Wheeler Environmental Corporation
GA/GAA/GB	CTDEP Groundwater Quality Classifications
GAC	Granular activated carbon
GMP	Groundwater Monitoring Plan

HCB	Hexachlorobenzene
HDPE	High-density polyethylene
HHRA	Human health risk assessment
HI	Hazard index
HQ	Hazard quotient
HSWA	Hazardous and Solid Waste Amendment
IAS	Initial Assessment Study
ICR	Incremental cancer risk
IR	Installation Restoration
LUC	Land use control
MCL	Maximum Contaminant Level
mg/kg	Milligrams per kilogram (parts per million)
mg/L	Milligrams per liter (parts per million)
NAVD	North American Vertical Datum
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEX	Naval Exchange
NFA	No Further Action
ng/kg	Nanograms per kilogram (parts per million)
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSA	New Source Area
NSB-NLON	Naval Submarine Base New London
NTCRA	Non-Time-Critical Removal Action
NTU	Nephelometric turbidity unit
O&M	Operation and maintenance
OBDA	Overbank Disposal Area
OBDANE	Overbank Disposal Area Northeast
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
POTW	Publicly owned treatment works
PPE	Personnel protective equipment
PRG	Preliminary Remediation Goal
RA	Remedial action
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund

RAO	Remedial action objective
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RCSA	Regulations of Connecticut State Agencies
RD	Remedial Design
RfD	Reference dose
RG	Remedial goal
RI	Remedial Investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
RSR	Remediation Standard Regulations (Connecticut)
SARA	Superfund Amendments and Reauthorization Act
SCS	Soil Conservation Service
SVOC	Semivolatile organic compound
SWPC	Surface water protection criterion
SwSV	Surface water screening value
TAG	Technical Assistance Grant
TAL	Target Analyte List
TBC	To Be Considered
TCE	Trichloroethene
TCL	Target Compound List
TPH	Total petroleum hydrocarbons
TSS	Total suspended solids
TtNUS	Tetra Tech NUS, Inc.
U.S.C.	United States Code
USGS	United States Geological Survey
UST	Underground storage tank
VC	Vinyl chloride
VOC	Volatile organic compound
WQS	Water Quality Standard
µg/kg	Micrograms per kilogram (parts per billion)
µg/L	Micrograms per liter (parts per billion)

GLOSSARY OF TECHNICAL TERMS

This glossary defines terms used in this Record of Decision (ROD). The definitions apply specifically to this ROD and may have other meanings when used in different circumstances.

Administrative Record File: A file that contains all information used by the lead agency to make its decision in selecting a response under CERCLA. This file is to be available for public review, and a copy is to be established at or near the site, usually at one of the Information Repositories. Also, a duplicate is filed in a central location such as a regional or state office.

Applicable or Relevant and Appropriate Requirements (ARARs): Federal environmental and state environmental and facility siting rules, regulations, statutes, and criteria that must be met by the Selected Remedy under Superfund.

Carcinogen: A substance that may cause cancer.

Chemical of concern (COC): A regulated chemical that is present at a concentration deemed to pose an unacceptable risk to human health or the environment, taking into account the acceptable level of risk land use definitions (i.e., current and reasonable potential future), and exposure scenario (i.e., completed pathways).

Chemical of potential concern (COPC): A chemical identified as a potential concern to human health or the environment through a screening-level assessment because its concentration exceeds regulatory criteria.

Comment period: A time during which the public can review and comment on various documents and actions taken either by the Navy, EPA, or CTDEP. For example, a comment period is provided when EPA proposes to add sites to the National Priorities List. A minimum 30-day comment period is held to allow community members to review the Administrative Record file and review and comment on the Proposed Plan.

Community relations: The Navy and NSB-NLON program to inform and involve the public in the Superfund process and to respond to community concerns.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601 et seq.: A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and

Reauthorization Act (SARA), Public Law 99-499. The act created a special tax that goes into a trust fund to investigate and clean up abandoned or uncontrolled hazardous waste sites.

Contamination: Any physical, biological, or radiological substance or matter that, at a certain concentration, could have an adverse effect on human health and the environment.

Data Gap Investigation (DGI): A follow-up investigation performed to address data gaps identified in the results of the previous investigation.

Feasibility Study (FS): A report that presents the development, analysis, and comparison of remedial alternatives.

Five-Year Review: Review of any remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site. The review is conducted no less often than each 5 years after the initiation of the remedial action.

Groundwater: Water found beneath the earth's surface. Groundwater may transport substances that have percolated downward from the ground surface as it flows towards its point of discharge.

Hazard index (HI): Sum of the HQs for all chemicals and all routes of exposure.

Hazard quotient (HQ): The ratio of the daily intake of a chemical from on-site exposure divided by the reference dose (RfD) for that chemical. The RfD represents the daily intake of a chemical that is not expected to cause adverse health effects.

Incremental cancer risk (ICR): The incremental increase in the probability of developing cancer during one's lifetime from exposure to carcinogenic chemicals in addition to the background probability of developing cancer. The EPA ICR goal is between $1x10^{-6}$ (1 in a million) and $1x10^{-4}$ (1 in ten thousand) chance of cancer. Cancer risk less than or within the risk goal is considered an acceptable risk level by the EPA. The CTDEP ICR Guideline is $1x10^{-5}$ (1 in a hundred thousand) and applies to cumulative risk posed by multiple contaminants. The state's acceptable carcinogenic risk for individual pollutants is $1x10^{-6}$ (1 in a million).

Information Repository: A file containing information, technical reports, and reference documents regarding a Superfund site that is made available to the public.

Installation Restoration (IR) Program: The purpose of the program is to identify, investigate, assess, characterize, and clean up or control releases of hazardous substances, and to reduce the risk to human health and the environment from past waste disposal operations and hazardous material spills at Navy activities in a cost-effective manner.

Institutional controls: Institutional Controls are a subset of land use controls and are primarily legal mechanisms (non-engineering) imposed to ensure the continued effectiveness of land use restrictions imposed as part of a remedial decision. Legal mechanisms include restrictive covenants, negative easements, equitable servitudes, and deed notifications. Administrative mechanisms include notices, adopted local land use plans and ordinances, construction permitting, or other existing land use management systems that may be used to ensure compliance with use restrictions.

JP-10: A popular missile fuel which is a single-component hydrocarbon ($C_{10}H_{16}$), rather than a mixture of many hydrocarbons. JP-10 fuel is a storable liquid.

Land use controls (LUCs): Any type of physical, legal, or administrative mechanism that restricts the use of, or limits access to, real property including water resources to prevent or reduce risks to human health and the environment. Physical mechanisms encompass a variety of engineered remedies to contain or reduce contamination and/or physical barriers to limit access to property, such as fences or signs. The legal mechanisms used for LUCs are generally the same as those used for institutional controls.

Monitoring: Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300: Federal regulations that provide the organizational structure and procedures for preparing for and responding to discharges of oil and release of hazardous substances, pollutants, or contaminants.

National Priorities List (NPL): The EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial response. The list is based on the score a site receives in the Hazard Ranking System. EPA is required to update the NPL at least once a year.

Natural degradation: Natural degradation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil and groundwater. These in-situ

processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants.

Operable Unit (OU): Operable units are site management tools that define discrete steps towards comprehensive actions as part of a Superfund site cleanup. They can be based on geological portions of a site, specific site problems, initial phases of action, or any set of actions performed over time or concurrently at different parts of the site.

Organic compounds: Naturally occurring or man-made chemicals containing carbon. Volatile organics can evaporate more quickly than semivolatile organics. Some organic compounds may cause cancer; however, their strength as cancer-causing agents can vary widely. Other organics may not cause cancer but may be toxic. The concentrations that can cause harmful effects can also vary widely.

Otto Fuel II: Otto Fuel II is a distinct-smelling, reddish-orange, oily liquid that the Navy uses as a fuel for torpedoes and other weapon systems. It is a mixture of three synthetic substances: propylene glycol dinitrate (the major component), 2-nitrodiphenylamine, and cibutyl sebacate and produces hydrogen cyanide when burned. Propylene glycol dinitrate, a colorless liquid with an unpleasant odor, is explosive. 2-Nitrodiphenylamine is an orange solid used to control the explosion of propylene glycol dinitrate. Dibutyl sebacate is a clear liquid used for making plastics, many of which are used for food packaging. It is also used to enhance flavor in some foods such as ice cream, candy, baked goods, and nonalcoholic drinks, and is found in some shaving creams.

Polynuclear aromatic hydrocarbons (PAHs): High molecular weight, relatively immobile, and moderately toxic solid organic chemicals featuring multiple benzenic (aromatic) rings in their chemical formula. Typical examples of PAHs are naphthalene and phenanthrene.

Proposed Plan: A public participation requirement of SARA in which the lead agency summarizes for the public the preferred cleanup strategy and the rationale for preference and reviews the alternatives presented in the detailed analysis of the FS. The Proposed Plan may be prepared either as a fact sheet or as a separate document. In either case, it must actively solicit public review and comment on all alternatives under consideration.

Record of Decision (ROD): An official document that describes the selected Superfund remedy for a site. The ROD documents the remedy selection process and is issued by the Navy and EPA following the public comment period.

Remedial Investigation (RI): A report that describes the site, documents the nature and extent of contaminants detected at the site, and presents the results of the risk assessment.

Remedial action: The actual construction or implementation phase that follows the remedial design for the selected cleanup alternative at a site on the NPL.

Response action: As defined by CERCLA Section 101(25), response actions include removal or remedial actions, including enforcement activities.

Responsiveness Summary: A summary of written and oral comments received during the public comment period, together with the Navy's and EPA's responses to these comments.

Risk assessment: Evaluation and estimation of the current and future potential for adverse human health or environmental effects from exposure to contaminants.

Site Use Restrictions document: SOPA (ADMIN) New London Instruction 5090.18D, Installation Restoration Site Use Restrictions at Naval Submarine Base New London defines Navy policy and procedures regarding disturbance of contaminated soil/sediment and/or extraction of contaminated groundwater. The locations of impacted media are also identified in figures provided in the Instruction.

Source: Area(s) of a site where contamination originates.

Superfund: The trust fund established by CERCLA that can be drawn on to plan and conduct cleanups of past hazardous waste disposal sites and current releases or threats of releases of non-petroleum products. Superfund is often divided into removal, remedial, and enforcement components.

Superfund Amendments and Reauthorization Act (SARA): The public law enacted on October 17, 1986, to reauthorize the funding provisions and amend the authorities and requirements of CERCLA and associated laws. Section 120 of SARA requires that all federal facilities be subject to and comply with this act in the same manner and to the same extent as any non-government entity.

TH Dimer: Tetrahydromethylcyclopentadiene, also called RJ-4, is a fuel developed for ram-jet missiles. It has been used for the Navy Sea Launched Cruise Missile. It can be used alone or blended with other fuels (e.g., a component of JP-9 jet fuel).

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

This Final Record of Decision (ROD) includes the groundwater at the following sites:

- Site 2A - Area A Landfill
- Site 2B - Area A Wetland
- Site 3 - Area A Downstream Watercourses and Overbank Disposal Area (OBDA)
- Site 7 - Torpedo Shops
- Site 9 - Waste OT-5
- Site 14 - Overbank Disposal Area Northeast (OBDANE)
- Site 15 - Spent Acid Storage and Disposal Area
- Site 18 - Solvent Storage Area, Building 33
- Site 20 - Area A Weapons Center
- Site 23 - Tank Farm

These sites comprise the Basewide Groundwater Operable Unit (OU) 9.
Naval Submarine Base – New London (NSB-NLON)
Groton, Connecticut
CERCLIS ID No. CTD980906515

1.2 STATEMENT OF BASIS AND PURPOSE

This Final ROD for OU9 presents the Selected Remedies for the groundwater at Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23 at NSB-NLON, Groton, Connecticut. Sites 2A, 2B, 3, 7, 14, and 20 are located in the northern portion of NSB-NLON in close proximity to each other, and the groundwater beneath these sites is hydraulically connected. Sites 9, 15, 18, and 23 are located in the southern portion of NSB-NLON in close proximity to each other, and the groundwater beneath these sites is hydraulically connected. Groundwater at Sites 9, 15, 18, and 23 is also included in OU9. The Selected Remedies were chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 United States Code (U.S.C.) 9601 et seq., as amended by the Superfund Amendments and Reauthorization Act (SARA), Public Law 99-499, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300. These decisions are based on information contained in the Administrative Record file for these sites.

The United States Department of the Navy and the United States Environmental Protection Agency (EPA) Region I issue this Final ROD jointly. The State of Connecticut Department of Environmental Protection (CTDEP) concurs with the Selected Remedies (see Appendix A).

1.3 ASSESSMENT OF SITE

The remedial actions (RA) selected in this Final ROD for Sites 3, 7, 9, and 23 groundwater are necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from these sites.

The Navy has determined that No Further Action (NFA) is necessary for the groundwater at Sites 14, 15, 18, and 20 to protect public health or welfare or the environment. Groundwater at Sites 2A and 2B is currently monitored under a groundwater monitoring program selected as part of the remedy for OU1. Institutional controls, required under the OU1 ROD, will remain in place at Sites 2A and 2B as described in the Site Use Restrictions document.

1.4 DESCRIPTIONS OF SELECTED REMEDIES

A total of 12 OUs have been defined at NSB-NLON to address the 23 sites included in the NSB-NLON Installation Restoration (IR) Program. This Final ROD only applies to the Basewide Groundwater OU9, which includes groundwater at Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23. Before final remedies were chosen for Sites 2A, 2B, 9, and 23, an Interim ROD was signed to document selection of interim remedies for groundwater at the remaining OU9 sites (Navy, 2004e). This ROD documents the final actions for all of OU9.

The Selected Remedies for groundwater at Sites 3 and 7 and Sites 9 and 23 require the development and implementation of response measures that will protect human health and the environment from contaminated groundwater at these sites. NFA is necessary for groundwater at Sites 14, 15, 18, and 20. Groundwater monitoring and institutional controls will continue at Sites 2A and 2B as part of the OU1 remedy. The soil at Site 2 (OU1), Site 3 (OU3), Site 3 – New Source Area (NSA), Site 7 (OU8), Site 14 (OU8), Site 15 (OU6), Site 18 (a portion of OU11), and the soil and sediment at Site 20 (OU7) were addressed in separate RODs or other decision documents.

1.4.1 Sites 3 and 7

The final Selected Remedy for groundwater at Sites 3 and 7 is Institutional Controls with Monitoring. The Selected Remedy complies with regulatory requirements and includes the following major components:

- Continuation of institutional controls that identify the location and magnitude of groundwater contamination, restrict extraction and use of the groundwater, and control vapor intrusion (Site 3 only) based on land use. Institutional controls were initially implemented at Sites 3 and 7 in December 2006 in accordance with the Interim ROD. These interim controls are incorporated into this Final ROD. In the event of property transfer and with confirmation that contaminated groundwater remains at the sites, an environmental land use restriction pursuant to state law will be used to prohibit the use of groundwater.

- Continued monitoring of the degradation and potential migration of groundwater contaminants until concentrations decrease to levels at which unrestricted use of and unlimited exposure to groundwater may be permitted. The monitoring program at Sites 3 and 7 was initiated in May 2006 in accordance with the Interim ROD.

- Five-year reviews until the results of the monitoring program indicate that remedial goals have been reached.

1.4.2 Sites 9 and 23

The final Selected Remedy for groundwater at Sites 9 and 23 is Institutional Controls [SOPA (ADMIN) New London Instruction 5090.18D (Appendix B)]. The Selected Remedy complies with regulatory requirements and involves implementation of institutional controls that identify the location and magnitude of groundwater contamination and restrict extraction and use of the groundwater. In the event of property transfer and with confirmation that contaminated groundwater remains at the sites, an environmental land use restriction pursuant to state law will be used to prohibit the use of groundwater. Five-year reviews will be conducted until contaminant concentrations are shown to be protective of human health and the environment.

1.4.3 Sites 2A, 2B, 14, 15, 18, and 20

Groundwater at Sites 14, 15, 18, and 20 poses no current or future potential threat to human health or the environment; therefore, NFA is the Selected Remedy and the Navy will not implement any treatment, engineering controls, or institutional controls at these sites.

At Sites 2A and 2B, groundwater monitoring as described in the OU1 ROD (Navy, 1995) and institutional controls as described in the NSB-NLON IR Site Use Restrictions document will continue. No additional action is required under OU9 to address groundwater at these sites.

1.5 STATUTORY DETERMINATIONS

The final remedies for Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23 groundwater are protective of human health and the environment, comply with federal and state requirements that are applicable or relevant and appropriate to the remedial actions, and are cost effective.

The Selected Remedies for groundwater at Sites 3 and 7 and Sites 9 and 23 do not satisfy the statutory preference for treatment as a principal element of the remedy. Due to the sporadic and relatively low concentrations of contaminants in groundwater, the Navy has determined that incorporating technologies to actively reduce the toxicity of the contaminants on site would not be cost effective. Treatment is not necessary for groundwater at Sites 2A and 2B based on the OU1 ROD or at Sites 14, 15, 18, and 20 because the Selected Remedy is NFA.

Because the Selected Remedies will result in contaminants remaining on site in excess of remedial goals, institutional controls will be implemented to prevent exposure to contaminated groundwater and to ensure that the RAOs are achieved. The Selected Remedies for Sites 3 and 7 and Sites 9 and 23 will result in contaminants remaining in groundwater at the sites at concentrations that do not allow for unrestricted use and unlimited exposure; therefore, statutory reviews will be conducted within 5 years of initiation of remedial action, and every 5 years thereafter, to ensure that the remedies continue to protect human health and the environment. If the remedies are determined not to be protective of human health and the environment because the institutional controls have failed, the Navy will be required to undertake additional remedial action.

The selection of NFA remedies for groundwater at Sites 14, 15, 18, and 20 is based on investigation and risk assessment results indicating that no additional remedial actions are necessary to ensure protection of human health and the environment. Because the remedies will not result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, five-year reviews of these sites as part of OU9 will not be required. Five-year reviews of Sites 2A and 2B will continue under OU1.

1.6 ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD:

- Chemicals of concern (COCs) and their respective concentrations.
- Baseline risk represented by the COCs.

- Cleanup levels (i.e., remedial goals) established for COCs and the basis for these levels.

- If present, how source materials constituting principal threats would be addressed.

- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessments and ROD.

- Potential land and groundwater uses that will be available at the sites as a result of the Selected Remedies.

- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rates, and the number of years over which the remedy cost estimates are projected.

- Key factor(s) that led to selecting the remedies (i.e., description of how the Selected Remedies provide the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision).

Additional information can be found in the Administrative Record file for Sites 2A, 2B, 3, 9, 7, 14, 15, 18, 20, and 23.

1.7 AUTHORIZING SIGNATURES

The signatures provided on the following pages validate the selection of the final remedies for groundwater at OU9, Sites 2A, 2B, 3, 9, 7, 14, 15, 18, 20 and 23 by the Navy and EPA. CTDEP concurs with the Selected Remedies.

Concur and recommend for implementation:

29SEPT 2008

Mark S. Ginda, USN
Naval Submarine Base - New London

Date

Concur and recommend for implementation:

9-30-08

James T. Owens, III, Director
Office of Site Remediation and Restoration
EPA Region I

Date

2.0 DECISION SUMMARY

This ROD describes the remedies selected by the Navy and EPA for OU9, Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23 groundwater to protect human health and the environment. The Navy is the lead agency for CERCLA activities at NSB-NLON and provides the funding for the cleanup activities. EPA provides the primary regulatory oversight and enforcement for CERCLA activities at NSB-NLON, and CTDEP is also actively involved in supporting the activities as required under the Federal Facility Agreement (FFA) (EPA, 1995).

2.1 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

NSB-NLON is located in southern Connecticut in the Towns of Ledyard and Groton. NSB-NLON is situated on the eastern bank of the Thames River, approximately 6 miles north of Long Island Sound. It is bordered on the east by Connecticut Route 12, on the south by Crystal Lake Road, and on the west by the Thames River. The northern border is a low ridge that trends approximately east-southward from the Thames River to Baldwin Hill. A general facility location map is presented as Figure 2-1. The location of each IR Program site within NSB-NLON is shown on Figure 2-2.

2.1.1 Site 2A – Area A Landfill and Site 2B – Site A Wetland

Site 2 is located in the northeastern and north-central portions of NSB-NLON and includes Site 2A, the Area A Landfill, and Site 2B, the Area A Wetland. The Area A Landfill encompasses approximately 13 acres and is a relatively flat area bordered by a steep, wooded hillside that rises to the south, a steep wooded ravine to the west, and the Area A Wetland to the north. The general configuration of Site 2 and adjacent areas is shown on Figure 2-3.

The Area A Landfill opened around 1957. Incinerated combustible wastes were disposed at the site until 1963, followed by refuse and debris disposal until 1973, when landfilling operations ceased. The thickness of landfill materials is estimated to range from 10 to 20 feet. After closure, a concrete pad was constructed on a portion of the landfill. In the early 1980s, transformers and electrical switches stored on the pad were reported to be leaking. Petroleum compounds were poured from containers at the landfill and flowed into the Area A Wetland. Spent sulfuric acid solution from batteries was poured into trenches dug into the Area A Landfill for disposal and subsequently covered with soil.

The location of the Area A Wetland was undeveloped wooded land and possibly wetland until the late 1950s when dredge spoils from the Thames River were pumped to the Area A Wetland and contained within an earthen dike that extends from the Area A Landfill to the southern side of the Area A Weapons

Center. The thickness of dredge spoils ranges from 35 feet to 10 feet. A small pond is located at the southern portion of the wetland, within which 1 to 3 feet of standing water is present during all seasons. Phragmites is the predominant type of vegetation. It was reported that formulated (water-soluble) 1,1,1-trichloro-2,2-bis(4-chlorphenyl)ethane (DDT) was used in this area in the 1960s prior to the 1972 ban on DDT. The Area A Wetland encompasses approximately 26 acres.

2.1.2 Site 3 – Area A Downstream Watercourses and OBDA

Site 3 is located in the northern portion of NSB-NLON and includes undeveloped wooded areas featuring several small ponds, streams, and wetlands and recreation areas (golf course and lake for swimming). Site 3 covers approximately 75 acres. Site 3 receives surface water and groundwater recharge from the Area A Landfill (Site 2A), Area A Wetland (Site 2B), Site 7, Site 14, and surrounding areas and convey them to the Thames River. Site 3 includes North Lake and several small ponds (Upper Pond, Lower Pond, and OBDA Pond) and interconnected streams (Streams 1 through 6). The major sources of contamination to Site 3 included historical application of pesticides, abandoned disposal areas, and the septic system leach fields at Site 7. The general configuration of Site 3 and adjacent areas is shown on Figure 2-4.

The primary discharge points from Site 2B to Site 3 are through four 24-inch-diameter metal culvert pipes located within the dike that separates Site 2B from Site 3. The discharge from these culverts forms a small stream (Stream 4) that flows westward for approximately 200 feet into Upper Pond. Upper Pond discharges to Stream 3, which flows northward and then westward toward Triton Road (past the OBDANE site) to the entrance of Site 7. At this location, it meets the drainage channel from Site 7 and forms Stream 5. Stream 5 flows westward along Triton Road through the Small Arms Range, under Shark Boulevard, and eventually discharges to the Thames River at the Defense Reutilization and Marketing Office (DRMO) outfall. Upper Pond also has a discharge structure on the southern side. A second pond (Lower Pond), northwest of Upper Pond, is a natural depression and is recharged by groundwater inflow. The outlet of the pond forms Stream 2, which enters a storm sewer and flows to the west around North Lake.

Groundwater discharges from Site 2A to a small pond (the OBDA Pond) located at the base of the dike and the OBDA. Stream 1 flows from this pond westward toward North Lake, a recreational swimming area for Navy personnel. Under normal flow conditions, the stream enters a culvert that bypasses North Lake and discharges to a stream (Stream 6) below the outfall of the lake. Stream 6, which is formed by Stream 1, Stream 2, and the outflow of North Lake, flows westward under Shark Boulevard and through the golf course to the Thames River. North Lake is filled with potable water every year and drained at the end of the season. Surface water levels in North Lake do not appear to coincide with groundwater levels

in adjacent monitoring wells, indicating little hydraulic connection between surface water of North Lake and the shallow groundwater.

A nine-hole golf course covers a majority of the western portion of Site 3. It was reported that groundwater wells were used to provide irrigation water for the golf course until the early 1980s. These wells were eliminated, and municipal potable water is currently used for irrigation purposes.

Most of Site 3 is within designated Explosive Safety Quantity Distance (ESQD) arcs of Site 20; therefore, further development is not planned for this area. Navy regulations prohibit construction of inhabited buildings or structures within these arcs and, although existing buildings operate under a waiver of these regulations, no further construction is planned.

2.1.3 Site 7 – Torpedo Shops

Site 7 is located in the northern portion of NSB-NLON on the northern side of Triton Road. Figure 2-5 shows the general site arrangement. The site is bordered on the east and north by 60-foot-high bedrock cliffs. The remainder of the site slopes to the southwest towards Site 3. An earthen berm extends along the base of the eastern portion of the exposed rock face. Four buildings (325, 450, 477, and 528) exist at the site.

Building 325 is a torpedo overhaul facility. A variety of fuels, solvents, and petroleum products have been used in Building 325 including Otto Fuel II [which is comprised of propylene glycol dinitrate (76 percent), 2-nitrodiphenylamine (1.5 percent), and di-n-butyl sebacate (22.5 percent) and produces hydrogen cyanide when burned], high-octane alcohol (190-proof grain alcohol), and TH-Dimer (jet rocket fuel). Solvents including mineral spirits, alcohol, and 1,1,1-trichloroethane and petroleum products such as motor oil and grease were also used in this building. A sink in one area was previously used for film development, and another sink was used for the overhaul of alkaline batteries. This plumbing drained into the on-site septic system until 1983. A maintenance area has a shallow sump covered with flush-mounted steel grating. The area surrounding this sump was previously a washdown/blowdown area for weapons. It is not known where this sump drains, although it may drain into the south leach field. Two underground and one above-ground storage tanks were located on the southern side of Building 325 and used to store fuel oil.

A smaller building attached to the eastern side of Building 325 was previously used as an assembly shop for torpedoes and as a paint shop. A closet in this building was used to store containers of 1,1,1-trichloroethane and methyl ethyl ketone (2-butanone). Drums and cylinders were stored outside on the eastern side of this building. The vessels were labeled as containing propane, isobutane,

2-butanone, xylot, methylene chloride, propellant, and zinc chromate. An addition to the northern side of Building 325, completed in 1990, is also used as a torpedo maintenance shop.

Building 450 is the primary MK-48 torpedo overhaul/assembly facility. Petroleum products including TL-250 motor oil and hydraulic fluid have also been used in this building for torpedo maintenance. Torpedo overhaul/assembly operations at Building 450 generate fuels, solvents, and petroleum products as wastes. An Otto fuel and seawater mixture is drained from the torpedoes and replenished with fresh fuel. The Initial Assessment Study (IAS) Report [Envirodyne Engineers, Inc. (Envirodyne), 1983] indicated that Building 450 generates approximately 3,000 gallons of Otto fuel wastewater per month. This building was constructed with a waste collection system that collected waste products from floor drains and discharged them to an underground waste tank/sump with a capacity of approximately 1,500 gallons. The waste tank was pumped periodically and the contents were disposed off site. Otto fuel product was previously stored in a 4,000-gallon underground tank south of Building 450. The hazardous waste sump was decommissioned in 1987. It was replaced with three 1,000-gallon above-ground tanks located south of the building. The floor drains were sealed and replaced with a new system for pumping waste products to the new tanks. A 4,000-gallon above-ground Otto fuel storage tank replaced the previous tank and is located south of the building.

Building 477, approximately 65 feet east of Building 450, was formerly used to store drums of Otto fuel. Solvents including 1,1,1-trichloroethane, trichloroethene (TCE), toluene, mineral spirits, alcohol, and bulk Freon have been used at this facility.

2.1.4 Site 9 – Waste OT-5

Site 9 included OT-5, a former underground concrete storage tank, located within Site 23 (see Section 2.1.9 and Figure 2-6). The soil at Site 9 was investigated and remediated and a corrective action was completed under the CTDEP RCRA UST Program; therefore, no decision documents were required or prepared for Site 9 soil. The tank was constructed in the 1940s and was used to store fuel oil. The tank had a capacity of approximately 750,000 gallons. In the late 1970s, the tank was converted to a storage tank for bilge water and other waste solutions. Use of OT-5 was discontinued in 1993, and all tank contents were removed. A residual sludge layer of approximately 2 to 3 inches was left in the tank during purging. This sludge contained polychlorinated biphenyls (PCBs) at concentrations exceeding 500 mg/kg. After OT-5 was emptied, groundwater infiltrated through cracks in the concrete surface and partially refilled the tank. Residual materials were removed in 1994. After the contents of OT-5 were removed, the tank was cleaned and the top of the tank was crushed. The tank was closed in place by filling it with inert material. Because Site 9 is located within the site boundaries of Site 23, Site 9 groundwater was evaluated and is being addressed with Site 23 groundwater.

2.1.5 Site 14 – OBDANE

Site 14 is located between Sites 7 and 20 in a wooded area on the edge of a ravine just north of Stream 3 in Site 3 (see Figure 2-4). Miscellaneous wastes were dumped at the site in the past. Historical reports state that the vegetation at the site indicated that no dumping had occurred within 10 years prior to 1982. Inspection of the site verified the presence of several empty fiber drums. No visual soil staining or stressed vegetation was observed. The site was circular and approximately 80 feet in diameter. A dirt road provides limited access to the site. A nearly vertical 20-foot-high bedrock face is located at the eastern edge of the site. The rest of the site slopes to the southwest.

2.1.6 Site 15 – Spent Acid Storage and Disposal Area

Site 15 is located in the southern portion of NSB-NLON and was used before and after World War II for the temporary storage of waste battery acid in a rubber-lined underground tank located between the southern sides of Buildings 409 and 410. The site location and historical and recent sampling locations are shown on Figure 2-7. The site's location relative to other IR Program sites is depicted on Figure 2-2.

2.1.7 Site 18 – Solvent Storage Area, Building 33

Site 18 consists of Building 33, the Solvent Storage Area. The building was used for the storage of gas cylinders and 55-gallon drums of solvents. The location of Building 33 is shown on Figure 2-2 and Figure 2-8.

2.1.8 Site 20 – Area A Weapons Center

Site 20 consists of Building 524 and the weapons storage bunkers. The storage bunker area is divided into two portions (north and south areas) that were constructed at different times and are of different design. The site is located at the eastern end of Triton Road, adjacent to the northern side of the Site 2B. The general configuration of Site 20 is shown on Figure 2-9.

Site 20 is located near the top of a local topographic and bedrock high. Building 524 was constructed in 1990 and 1991. Portions of the site were blasted to remove bedrock to accommodate construction of the building. The weapons storage bunkers are located southeast and downhill of Building 524 and are adjacent to and at a slightly higher elevation than the Area A Wetland.

Building 524 is used for administration, minor torpedo assembly, and storage of simulator torpedoes. No weapons production takes place in this building. Small quantities of chemicals and chemical waste generated by activities in this building are stored in 1- to 5-gallon containers in seven metal storage

cabinets located on a paved area south of the building. The chemicals include cleaning and lubricating compounds, paints, and adhesives. Many of these materials are classified as corrosive or flammable.

Liquid fuels present in the weapons storage bunkers include Otto fuel, JP-10, and TH Dimer (jet rocket fuel). The group of southern area bunkers was reconstructed in the last 15 years. A major part of the reconstruction involved removal of structurally unsuitable soil from the site.

2.1.9 Site 23 – Tank Farm

Site 23, Tank Farm, is located in the southern portion of NSB-NLON and includes nine former USTs that were demolished and closed in place, a 30,000-gallon, double-walled UST (OT-10), a 10,000-gallon waste oil tank, a fuel oil loading area, a tanker truck dumping pad and trough, associated UST piping systems, baseball/softball fields, buildings that housed the former air sparging/soil vapor extraction (AS/SVE) facility for the Naval Exchange (NEX) service station, two 150,000-gallon diesel above-ground storage tank (ASTs), and other buildings. The general configuration of Site 23 is shown on Figure 2-6.

Each of the nine USTs had a holding capacity of 750,000 gallons. No. 6 fuel oil was stored in tanks OT-1 through OT-3 from the date of construction until they were removed from service in the summer of 1991. Tanks OT-7 through OT-9 were decommissioned in the summer of 1990 and were used exclusively for storage of diesel during all 48 years of service. A reduced demand for diesel fuel at NSB-NLON in the mid-1970s led to the decommissioning and demolition of tank OT-6. The reduced demand for diesel also led to the modification of tank OT-5 for waste oil storage purposes. Tank OT-4 was used to store tank bottom wastes from OT-1. Tank OT-5 was used as part of an oil/water separator system (see Site 9 discussion below). Tanks OT-4 and OT-5 were reportedly decommissioned after installation of a new 30,000-gallon waste oil underground tank (OT-10) in 1990. Tanks OT-1 through OT-9 have been demolished and closed in place. A number of petroleum releases were documented by the Navy in the vicinity of the Tank Farm, and evidence of releases of petroleum products from these tanks, their associated piping, and possibly from other nearby sources was detected during previous investigations.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.2.1 Site History

2.2.1.1 Site 2

Site 2A

A Phase I Remedial Investigation (RI) (Atlantic, 1992), Focused Feasibility Study (FS) (FFS) (Atlantic, 1995b) and Phase II RI (B&RE, 1997) were conducted for the Site 2A, Area A Landfill. The Phase II RI

concluded that shallow groundwater contamination existed at the site, that the landfill soil may pose a threat to human receptors due to concentrations of PCBs, and that chemicals in soil could adversely impact ecological receptors. To address Site 2A soil (OU1), an RA that involved the construction of a 13-acre low-permeability cover system over the landfill area was performed in 1997. The groundwater at the Area A Landfill is currently being monitored as part of the OU1 compliance monitoring program. Groundwater at the site was also investigated as part of the BGOURI (TtNUS, 2002a), which recommended that the monitoring program be continued to gather data to evaluate long-term trends in contaminant concentrations and the decision to proceed to an FS should be made after sufficient data have been collected and evaluated. Land use controls (LUCs) have been implemented at the landfill to meet the requirements in the soil ROD. A majority of the Area A Landfill is paved and is currently used for storage of equipment and vehicles.

The initial Groundwater Monitoring Plan (GMP) (TtNUS, 1999) for Site 2 called for monitoring groundwater and surface water for semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), metals, pesticides/PCBs, and various field parameters. After 4 years of monitoring, the monitoring program was revised to discontinue monitoring for VOCs, pesticides, and PCBs because no exceedances of these compounds were detected in 4 years.

Site 2 has now been monitored for 8 years. The most recent results available, those from Year 7 (2006), determined that the only contaminant detected in groundwater in excess of criteria is copper, and this was in a reference well, not a downgradient well. Overall, the results of 8 years of monitoring indicate that the cap system is working properly and that significant contaminant migration from the site to surrounding areas is not occurring.

Site 2B

The Phase I and II RIs (1992 and 1997, respectively) and the BGOURI (2002) included investigations of the Site 2B, Area A Wetland. Area A Wetland sediment was identified as OU12 and is still being investigated under CERCLA.

A phased RI was conducted to determine the nature and extent of contamination at the Area A Wetland. The Phase I RI field conducted from 1990 to 1992 (Atlantic, 1992) concluded that risks associated with several exposure scenarios exceeded acceptable regulatory levels and that an FS should be performed for the Area A Wetland site. The Phase II RI (B&RE, 1997) concluded that little surface water or groundwater contamination exists at the site, that the site may pose a risk to a construction worker due to potential exposure to manganese in the groundwater, and that significant pesticide, PCB, and PAH concentrations exist in site soil and sediment. The Phase II RI recommended that an FS should be

conducted for this site to evaluate a limited action alternative including groundwater monitoring and access/use restrictions.

A Phase III investigation of the sediments at the Area A Wetland was conducted in October 2007. The major objectives of the investigation were to further refine the nature and extent of contamination in sediments and to provide sufficient data to determine potential risks to ecological receptors from contaminated sediments. A secondary objective of the investigation was to determine the thickness of the overlying organic layer that has formed above the dredge spoils. The evaluation of the investigation results was ongoing at the time of preparation of this ROD; therefore, no conclusions from the investigation were available.

Groundwater at the Area A Wetland is currently being monitored under the Area A Landfill long-term groundwater monitoring program (OU1).

2.2.1.2 Site 3

Site 3, Area A Downstream Watercourses, covers approximately 75 acres and contains mainly undeveloped wooded areas and recreational areas. The Site 3 watercourses include several small ponds and interconnected streams (Figure 2-4) that convey surface water to the Thames River. The major sources of contamination at Site 3 include historical application of pesticides for mosquito control, abandoned disposal areas, and the septic system leach fields at Site 7. There are relatively few buildings (Buildings 223, 281, 282, 376, 454, and 468) at Site 3. Most of these buildings are associated with the recreational area at North Lake and the golf course, which comprises a large portion of the site area. Further development is not planned for this area because most of it is within designated ESQD arcs of Site 20.

An earthen dike was constructed in 1957 in the area between Sites 2 and 3. The valley on the eastern side of the dike was filled with dredge spoils from the Thames River, which created Site 2B. The Site 3 ponds were created to act as settling ponds for any dredge spoil that was discharged from the Site 2B.

Site 3 also included the OBDA. The OBDA was located on the slope of the dike below and adjacent to the Area A Landfill. It was located on the southwestern end of the dike, and a small wetland exists at the base of the dike. The OBDA was used as a disposal site after the earthen dike was constructed in 1957. Materials disposed at the site included thirty 200-gallon metal fuel tanks (unlabeled), scrap lumber/old creosote telephone poles, several empty unlabeled 55-gallon drums, and rolls of wire.

Site 3 was investigated during several phases from 1990 to 2002, including the Phase I RI (Atlantic, 1992), FFS (Atlantic, 1994b), Phase II RI (B&RE, 1997), BGOURI (TtNUS, 2002a), and Data Gap

Investigation (DGI) for the BGOURI Update/FS (TtNUS, 2004). During completion of the Phase II RI, the Navy and regulators decided that the best strategy was to address the source area OUs at the site first and then address the groundwater OU. Groundwater at Site 3 was further investigated during the BGOURI in 2000, but the results of the investigation were inconclusive and data gaps remained.

During the RA for OU3, Site 3 - NSA was discovered adjacent to Stream 5 at Site 3. Sediment that exhibited potential petroleum contamination (i.e., odor and sheen on pooled water) was encountered during excavation activities along the northern side of Stream 5. Upon further investigation, rusted drums and steel cable intermingled with boulders and soil were evident in a small disposal area upgradient (north) of Stream 5 (see Figure 2-4). A sample of the contaminated sediment was collected and analyzed. Elevated levels of total petroleum hydrocarbons (TPH) were detected in the sample, indicating the presence of petroleum contamination. The NSA was not remediated at the time of the OU3 RA; however, absorbent booms and hay bales were put in place during construction activities to minimize migration of the contamination downstream, and plastic sheeting was placed along the stream bank prior to backfilling to minimize further contaminant migration to Stream 5.

To address the newly found Site 3 - NSA and the data gaps identified during the BGOURI, a DGI (TtNUS, 2002b) was completed in the fall of 2002 prior to initiating an FS. The results of the DGI were presented and evaluated in the BGOURI Update/FS (TtNUS, 2004), and remedial alternatives were developed to address the petroleum-contaminated soil associated with Site 3 - NSA. A ROD (Navy, 2004d) was signed for the site in October 2004. The ROD called for NFA under the CERCLA Program for the petroleum-contaminated soil because petroleum is excluded from consideration under CERCLA; however, the Navy's cleanup plan to address the petroleum-contaminated soil under other applicable regulations was detailed in an appendix of the ROD. The Site 3 – NSA soil corrective action was completed to meet Connecticut regulations in October 2007.

2.2.1.3 Site 7

Site 7, Torpedo Shops, is located in the northern portion of NSB-NLON on the northern side of Triton Road (Figure 2-2). The Navy conducts maintenance activities on torpedoes at the site. OU8 is the soil OU associated with Site 7. The major sources of contamination at Site 7 included potential historic disposal of solvents/chemicals into two on-site septic systems and leaks or spills associated with on-site underground storage tanks (USTs). Contaminated soil was found on the southern side of Building 325 and appeared to be related to former USTs used to store fuel oil. Groundwater and suspected soil contamination on the western side of the building appeared to be related to the septic tank, sewer lines, or leach field associated with the former septic system. The USTs were closed in the 1990s, and the septic systems were abandoned when sanitary sewers were installed in 1983.

Building 325 (Figure 2-5) is a torpedo overhaul facility, and it was built in 1955 and had an on-site septic system until 1983, when all of the building's plumbing facilities were connected to sanitary sewers. The original septic leach field for Building 325 is located southwest of the building, adjacent to Triton Road. This leach field became clogged in 1975 and was abandoned. A new leach field (south leach field) was constructed next to the original leach field and was used until sanitary sewers were installed in 1983.

Two underground No. 2 fuel oil tanks were located on the southern side of Building 325. One of the tanks was closed in 1995. A third tank, which was located above ground adjacent to the building, was used for temporary storage of No. 2 fuel oil but, based on field reconnaissance, had been removed as of March 15, 1995.

Building 450 (Figure 2-5) is the primary MK-48 torpedo overhaul/assembly facility. It was built in 1974 and was served by its own septic system until 1983, when it was connected to sanitary sewers. Only domestic wastewater from toilets, lavatories, and showers in Building 450 had been directed to the septic field (north leach field).

Site 7 was investigated during the Phase I RI (Atlantic, 1992), Phase II RI (B&RE, 1997), and BGOURI (TtNUS, 2002a). The combined soil and groundwater data sets from the three investigations were evaluated during the BGOURI. No additional investigations were conducted at the site during the DGI for the BGOURI Update/FS (TtNUS, 2004).

A ROD (Navy, 2004b) was signed for the soil at the site (OU8) in September 2004 which called for the excavation and off-site disposal of contaminated soil. This remedy was selected because there were potentially significant risks associated with exposure to the contaminated soil. The Site 7 soil remedial action was completed in 2006.

2.2.1.4 Site 14

Site 14, OBDANE, where miscellaneous wastes were dumped in the past, was located adjacent to Sites 3 and 7 in a wooded area on the edge of a ravine just north of Stream 3 (Figure 2-4). Site 14 was investigated during the Phase I RI (Atlantic, 1992), Phase II RI (B&RE, 1997), and BGOURI (TtNUS, 2002a). A Non-Time-Critical Removal Action (NTCRA) was completed at the site in 2001 to address the contaminated soil and debris identified at the site during the Phase II RI. A ROD (Navy, 2004b) was signed for the soil at the site (OU8) in September 2004 which called for NFA. This remedy was selected because the NTCRA addressed all significant risks associated with the soil and debris.

Because Site 14 was located adjacent to Site 3 and groundwater from Site 14 flows toward Site 3, it was decided to evaluate the groundwater OU beneath both sites jointly and this approach was taken in the

BGOURI. Subsequently, it was decided that groundwater at Sites 3 and 14 should be evaluated separately because of the different remedial strategies that might be applicable to the different sites. This approach was used in the BGOURI Update/FS (TtNUS, 2004). No additional sampling was conducted at Site 14 during the DGI for the BGOURI Update/FS because no significant contamination was discovered in the groundwater during the BGOURI.

2.2.1.5 Site 15

Site 15, Spent Acid Storage and Disposal Area, was used before and after World War II for the temporary storage of waste battery acid in a rubber-lined underground tank. The tank was reportedly 12 feet long by 4 feet wide by 4 feet high. The batteries were placed on a concrete pad next to the tank onto which some acids occasionally leaked. No major spills were ever recorded. A 1951 aerial photograph shows that the area around the tank was not paved. Acid from the batteries was stored in the tank and was subsequently pumped into a tank truck and disposed in the Area A Landfill (Site 2). The tank was filled in place with soil and capped with bituminous pavement.

Historical investigations completed at Site 15 include the Phase I RI (Atlantic, 1992), FFS (Atlantic, 1994a), Phase II RI (B&RE, 1997), Supplemental Sampling Event (CTDEP, 1997), and BGOURI (TtNUS, 2002a). An NFA Decision Document for Soil at Site 15 was submitted in September 2007. Groundwater and soil data collected at Site 15 during the DGI was included and evaluated in the BGOURI Update/ FS Report (TtNUS, 2004). Soil results from this investigation confirmed that the NFA Decision Document was appropriate and not need to be amended.

2.2.1.6 Site 18

The solvent storage area at Building 33 was identified during the IAS (Envirodyne, 1983) for NSB-NLON. The site was identified as Study Area F in the FFA and is now identified as Site 18, Solvent Storage Area, Building 33, in the IR Program. Site 18 was used for the storage of gas cylinders and 55-gallon drums of solvents such as TCE and dichloroethene. The site was not identified as a high priority site and as a result, no investigation of Site 18 was conducted during the early phases of investigation at NSB-NLON (e.g., Phase I or Phase II RIs). The Navy investigated the site during the BGOURI in 2000 to determine the impact of the operation of the storage facility. Both soil and groundwater samples were collected to characterize the site. The results of the investigation were documented in the BGOURI Report (TtNUS, 2002a). A ROD (Navy, 2004c) was subsequently signed for the soil at Site 18 (OU11) in September 2004. The Selected Remedy documented in the ROD was NFA because no significant risks associated with exposure to site soil were identified during the RI.

2.2.1.7 Site 20

Site 20, Area A Weapons Center, consists of Building 524, which is used for administration, minor torpedo assembly, and storage of simulator torpedoes, and the weapons storage bunkers (see Figure 2-9). Small quantities of chemicals (cleaning and lubricating compounds, paints, and adhesives) and chemical waste generated by on-site activities are stored at the site. Liquid fuels present in the weapons storage bunkers include Otto fuel, JP-10, and TH Dimer (jet rocket fuel).

Site 20 was indirectly investigated during the Phase I RI (Atlantic, 1992) as part of the investigation of Site 2B. The site was further investigated during the Phase II RI (B&RE, 1997), BGOURI (TtNUS, 2002a), and DGI for the BGOURI Update/FS (TtNUS, 2004). The DGI (TtNUS, 2002b), which included collection and analysis of additional groundwater samples, was conducted at the site in the fall of 2002 to address data gaps identified during the BGOURI. A ROD (Navy, 2000) for the site soil and sediment (OU7) was signed and called for excavation and off-site disposal of the contaminated soil and sediment. The remedial action was completed in 2001 and consisted of excavation and off-site disposal of less than 200 cubic yards of PAH- and arsenic-contaminated soil and sediment.

2.2.1.8 Site 23

Site 23, Tank Farm, comprises various former and current tanks and associated facilities including nine former USTs, a 30,000-gallon, double-walled UST (OT-10), 10,000-gallon waste oil tank, fuel oil loading area, tanker truck dumping pad and trough, two 150,000-gallon diesel ASTs, and other buildings. Five of the nine former tanks at Site 23 (OT-1, OT-2, OT-3, OT-4, and OT-6) had perimeter underdrains installed around them during their construction to depress groundwater levels. In addition, the storm sewers that the underdrains tie into were constructed of perforated corrugated metal pipe to help dewater the area. The underdrain at OT-6 was subsequently abandoned by the Navy around 1966 during completion of improvements to the storm sewer system. The soil at Site 23 was remediated in 1997 and 2000 under the CTDEP Resource Conservation and Recovery Act (RCRA) UST Program.

The Site 23 USTs were properly closed in place; however, the tank underdrain systems were allowed to remain in place to help reduce groundwater levels in the area. Evidence of releases of petroleum products from the tanks, their associated piping, and possibly from other nearby sources was detected in soil during previous investigations. No significant groundwater contamination was detected; however, petroleum hydrocarbons were detected periodically at the outfall of the storm sewer system near Goss Cove. The stormwater drainage system was rehabilitated in 2000 such that the original combined groundwater and stormwater system was separated into a deep groundwater and a new shallow stormwater system. The groundwater underdrain system continues to collect groundwater from the old tank drains. In 2000, new storm drain was installed using solid wall HDPE piping and much of the underdrain was relined

with perforated plastic pipe. An existing manhole was modified to become a groundwater flow-metering and sampling pit. Beyond the metering pit, the groundwater underdrain pipe and stormwater collection pipes are recombined such that groundwater then enters the storm sewer system.

The objectives of the BGOURI at Site 23 were to further characterize the nature and extent of groundwater contamination and to quantify the risks to human receptors from the groundwater. Groundwater sampling results for Site 23 indicated that the water quality is generally good, with only sporadic, low-concentration detections of VOCs, SVOCs, and metals in site monitoring wells. A preliminary evaluation of natural attenuation data indicated that biodegradation and other natural attenuation processes might be acting to reduce organic contaminants to relatively insignificant levels in the Tank Farm. However, it was not recommended that a monitored natural attenuation alternative be pursued for the site. The BGOURI recommended that the decision for preparation of an FS for the groundwater OU at the Tank Farm be postponed until site conditions stabilize and the results of the sampling and analysis program for the groundwater collection system determined the trends in groundwater contaminant concentrations.

The Site 23 underdrain metering pit was sampled after construction and quarterly for a period of 1 year starting in June 2007. Samples were collected from the metering pit that collects groundwater from the Site 23 area underdrains from four former tanks. All relevant concentrations were less than established Connecticut criteria (with the exception of anomalous results as discussed in Section 2.5.2.7). Based on these results, Site 23 groundwater (including Site 9 groundwater) being collected and conveyed in the storm sewer system does not pose a significant threat to human health or the environment under the current land use scenario; however, risks would be unacceptable if groundwater at the site was used as a drinking water supply.

2.2.2 Enforcement Activities

On August 30, 1990, NSB-NLON was placed on the National Priorities List (NPL) by the EPA pursuant to CERCLA of 1980 and SARA of 1986. The NPL is a list of uncontrolled or abandoned hazardous waste sites identified by EPA as requiring priority RAs. The Navy, EPA, and the State of Connecticut signed the FFA for NSB-NLON in 1995 (EPA, 1995). The agreement is used to ensure that environmental impacts associated with past and present activities at NSB-NLON are thoroughly investigated and that the appropriate RA is pursued to protect human health and the environment. In addition, the FFA establishes a procedural framework and timetable for developing, implementing, and monitoring appropriate responses at NSB-NLON, in accordance with CERCLA (and SARA amendment of 1986, Public Law 99-499), 42 U.S.C. §9620(e)(1); the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 CFR 300; Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §6901 et seq., as amended by the Hazardous and Solid Waste Amendment (HSWA) of 1984, Executive Order 12580; and

applicable state laws. There have been no cited violations under federal or state environmental law or any past or pending enforcement actions pertaining to the cleanup of OU9.

2.3 COMMUNITY PARTICIPATION

The Navy has been conducting community relations activities for the IR Program at NSB-NLON since it began. From 1988 to November 1994, Technical Review Committee meetings were held on a regular basis. In 1994, a Restoration Advisory Board (RAB) was established to increase public participation in the IR Program process. Many community relations activities for NSB-NLON involve the RAB, which historically met quarterly and recently has met annually. The RAB provides a forum for discussion and exchange of information on environmental restoration activities between the Navy, regulatory agencies, and the community, and it provides an opportunity for individual community members to review the progress and participate in the decision-making process for various IR Program sites, including Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23.

The following community relations activities are conducted at NSB-NLON as part of the Community Relations Plan:

Information Repositories: *The Public Libraries in Groton and Ledyard are the designated information* repositories for the NSB-NLON IR Program. All pertinent reports, fact sheets, and other documents are available at these repositories.

Key Contact Persons: The Navy has designated information contacts related to the NSB-NLON. Materials distributed to the public, including any fact sheets and press releases, will indicate these contacts. The Public Affairs Officer will maintain the site mailing list to ensure that all interested individuals receive pertinent information on the cleanup.

Mailing List: To ensure that information materials reach the individuals who are interested in or affected by the cleanup activities at the NSB-NLON, the Navy maintains and regularly updates the site mailing list.

Regular Contact with Local Officials: The Navy arranges regular meetings to discuss the status of the IR Program with the RAB.

Press Releases and Public Notices: The Navy issues press releases as needed to local media sources to announce public meetings and comment periods, the availability of reports, and to provide general information updates.

Public Meetings: The Navy conducts informal public meetings to keep residents and town officials informed about cleanup activities at NSB-NLON, and at significant milestones in the IR Program. Meetings are conducted to explain the findings of the RI; to explain the findings of the FS; and to present the Proposed Plan, which explains the preferred alternatives for cleaning up individual sites.

Fact Sheets and Information Updates: The Navy develops fact sheets to mail to public officials and other interested individuals and/or to use as handouts at the public meetings. Each fact sheet includes a schedule of upcoming meetings and other site activities. Fact sheets are used to explain certain actions or studies, to update readers on revised or new health risks, or to provide general information on the IR Program process.

Responsiveness Summary: The Responsiveness Summary for the Proposed Plan summarizes public concerns and issues raised during the public comment period and documents the Navy's formal responses. The Responsiveness Summary may also summarize community issues raised during the course of the FS.

Announcement of the ROD: The Navy announces the signing of the ROD through a notice in actions or studies, to update readers on revised or new health risks, or to a major local newspaper of general circulation and a press release sent to everyone on the mailing list. The Navy places the signed ROD in the information repositories before any RAs begin.

Public Comment Periods: Public comment periods allow the public an opportunity to submit oral and written comments on the proposed cleanup options. Citizens have at least 30 days to comment on the Navy's preferred alternatives for cleanup actions as indicated in the Proposed Plan.

Technical Assistance Grant: A Technical Assistance Grant (TAG) from the EPA can provide up to $50,000 to a community group to hire technical advisors to assist them in interpreting and commenting on site reports and proposed cleanup actions. Currently, no TAG funds have been awarded.

Site Tours: The Office of Public Affairs periodically conducts site tours for media representatives, local officials, and others.

A notice of availability of the Proposed Plan for Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23 groundwater (Navy, 2008) was published on June 14, 2008, in *The New London Day* newspaper. The Proposed Plan and other documents related to these sites are available to the public in the NSB-NLON Information Repositories located at the Groton Public Library in Groton, Connecticut, and the Bill Library in Ledyard,

Connecticut. The notice also announced the start of the 30-day comment period that ended on July 14, 2008. A copy of the notice and the Proposed Plan are included in Appendix C of this ROD.

The Proposed Plan notice of availability invited the public to attend a public meeting at the Best Western Olympic Inn in Groton, Connecticut on June 26, 2008. The public meeting presented the proposed remedies and solicited oral and written comments. At the public meeting, personnel from the Navy, EPA, and the CTDEP answered questions from the attendees during the informal portion of the meeting. In addition, public comments on the Proposed Plan were formally received and transcribed. The transcript for the public meeting is provided in Appendix D. Responses to the comments received during the public comment period are provided in the Responsiveness Summary in Section 3.0.

2.4 SCOPE AND ROLE OF OPERABLE UNIT

Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23 are 10 of the 23 IR Program sites within the 12 OUs currently included in the NSB-NLON IR Program. The overall goal of the IR Program at NSB-NLON is to cleanup sites to achieve compliance with State of Connecticut Remediation Standard Regulations (RSRs) and other ARARs. As with many Superfund sites, the problems at these sites are complex. As a result, the media at Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23 have been divided into separate OUs as follows:

- OU1 - Site 2A, Area A Landfill soil and groundwater.
- OU3 - Site 3 soil and sediment.
- OU6 - Site 15 soil.
- OU7 - Site 20 soil and sediment.
- OU8 - Sites 7 and 14 soil.
- OU9 - All groundwater in the Upper Subase of NSB-NLON including Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23.
- OU11 - Sites 16 and 18 soil.
- OU12 - Site 2B, Area A Wetland, sediment.

Interim remedies were selected for Sites 3, 7, 14, 15, 18, and 20 groundwater in the Interim ROD (Navy, 2004e). This Final ROD documents the selection of final remedies for all portions of OU9. The remedies selected for Site 2 soil and groundwater, Site 3 - NSA soil, Sites 7 and 14 soil, and Site 18 soil were documented in separate RODs (Navy, 1995, 2004b, 2004c, and 2004d). Site 15 soil (OU 6) was previously addressed by the Navy in a NFA Source Control ROD in 1997 (Navy, 1997b).

The Selected Remedies for groundwater at Sites 3 and 7 and Sites 9 and 23 will prevent potential future unacceptable risks to human health and the environment associated with contaminants in groundwater at

these sites. The results of the risk assessments indicated no unacceptable risks to current receptors from exposure to groundwater at Sites 3 and 7 and Sites 9 and 23, but exposure to maximum concentrations of contaminants in groundwater at the sites could result in unacceptable risks to hypothetical future human receptors if they regularly consume the groundwater. In addition, based on the results of a 2008 vapor intrusion evaluation, vinyl chloride concentrations in groundwater at one well at Site 3 present unacceptable risks to humans if a building was built for residential purposes in the vicinity of this well.

Evaluation of the available analytical data indicated that no unacceptable health effects are anticipated from exposure to the groundwater at Sites 2A, 2B, 14, 15, 18, and 20. An NFA remedy was selected for the groundwater at Sites 14, 15, 18, and 20. Groundwater monitoring and institutional controls will continue at Sites 2A and 2B as part of the OU1 remedy.

2.5 SITE CHARACTERISTICS

2.5.1 Physical Setting

2.5.1.1 Site 2A – Area A Landfill and Site 2B – Area A Wetland

Sites 2A and 2B are located within a northwest-trending valley (northern valley) situated between the topographic/bedrock high that occupies the central area of the NSB-NLON and the topographic/bedrock high that forms the northern border of the NSB-NLON. Figure 2-4 shows the topography and surface features of these sites. The northern valley is relatively narrow in the eastern portion of the site near the earthen dike, but it widens to the west. Runoff from Site 2A drains as overland flow north into the Area A Wetland (Site 2B), which discharges to Area A Downstream Watercourses, Site 3.

Site 2A

Site 2A, located in the eastern portion of the northwest-trending valley, contains 10 to 20 feet of miscellaneous fill that consists of fine- to coarse-grained sand and gravel and ash, wood and brick fragments, paper, and asphalt. The fill is generally underlain by 10 to 20 feet of dredge spoils, mainly beneath the easternmost portion of the landfill. Where no spoils underlie the fill material, the fill directly overlies a thin alluvial layer or the bedrock surface. Along the southeastern border of the landfill, fill material is underlain by an alluvial layer consisting of silty sand. The alluvial layer is underlain by gravel and gneiss boulders. Bedrock beneath Site 2 has been identified as the biotite-quartz-feldspar gneiss of the Mamacoke Formation. The bedrock surface slopes to the northeast toward Site 2B from the large bedrock high in the center of the facility. In the western portion of the site, the landfill is situated immediately adjacent to a bedrock ridge, and depth to bedrock is typically less than 20 feet. The eastern portion of the landfill is located further from the hillside, and depth to bedrock increases to 70 feet in this area.

Groundwater is present within the dredge spoils, alluvium, and bedrock underlying the Area A Landfill. Depth to groundwater averages approximately 10 feet across the landfill, and in some areas, the lower portion of the fill materials is below the water table. The saturated thickness of the overburden materials ranges from less than 10 feet to at least 65 feet across the landfill. Overburden and bedrock groundwater flow northeast across most of Site 2A, from the topographic/bedrock high to Site 2B, the Area A Wetland. Upward groundwater gradients from bedrock to the overburden/fill are predominant, although a downward gradient exists at the 2LMW18 well cluster, located in the central portion of the landfill. Hydraulic potentials between bedrock and overburden groundwater differ by 3 to 7 feet, suggesting that although groundwater flow directions are similar, the degree of hydraulic connection varies spatially, and there is no restriction of flow between the overburden and bedrock in some areas. East of Site 2A, local groundwater flow is to the north and west into Site 2B. In this area, groundwater elevations in bedrock and the overburden are similar, and vertical gradients are minimal. In the western portion of the landfill near the dike, groundwater flows northwest toward Site 3.

The geometric mean hydraulic conductivity for the overburden, based on Phase II RI pumping test data, is 2.7 feet per day. This value corresponds to overburden hydraulic conductivities estimated based on slug tests conducted during the Phase II RI. Based on a hydraulic gradient of 0.033 across the landfill (from 1993 water level measurements), hydraulic conductivity of 2.7 feet per day, and an assumed effective porosity of 30 percent, the average seepage velocity is estimated at 0.3 foot per day. Figures 2-10 and 2-11 show regional groundwater flow patterns across Sites 2, 3, and 14 in the shallow overburden and bedrock, respectively, based on the August 2000 round of water-level measurements taken during the BGOURI.

Site 2B

Site 2B is underlain by dredge spoils that consist of silt and clay with traces of fine sand and shell fragments. The dredge spoils extend across the site southeast to 2WMW3 and southwest beneath the Area A Landfill. The thicknesses of dredge spoils are 25 to 35 feet on the southern side of the wetland and 10 to 15 feet on the northeastern side of the wetland. Where dredge spoils do not directly overlie bedrock, they are underlain by a thin remnant of topsoil consisting of organic-rich silt, clay, and traces of roots and underlain by alluvial deposits. The alluvial deposits consist primarily of sand with silt and/or gravel and are significantly coarser grained than the overlying dredge spoils. The thickness of the alluvium in Site 2B borings ranged from 0 to 36 feet. Bedrock beneath the southern portion of the wetland has been identified as the Mamacoke Formation; the northernmost portion of the wetland is underlain by the Granite Gneiss, a gneissic biotite granite. The bedrock surface slopes to the valley occupied by the wetland from northern, eastern, and central bedrock highs toward the center of the wetland.

Groundwater is present within the overburden and bedrock underlying the Area A Wetland, and the water table is close to the ground surface throughout most of the area. The dredge spoils and alluvium making up the overburden exist largely under saturated conditions. Groundwater flow in the overburden is from the northeast and southwest into the wetland and then west toward Site 3 (see Figures 2-10 and 2-11). Groundwater flow in the bedrock mimics the shallow overburden pattern and flows from higher elevations toward the bedrock valley and ultimately to site 3 through a combination of discharge to local streams and aquifer underflow. Groundwater elevations are similar in the overburden and bedrock, but the vertical gradient varies from upward to downward. Based on 1994 water level measurements, the hydraulic gradient in dredge spoils at the site is 0.00255, and hydraulic conductivity is 1.0 foot per day based on slug testing during the Phase I RI. Assuming an effective porosity of 0.30, the estimated groundwater seepage velocity through the dredge spoils is 0.008 foot per day. For the alluvium, a hydraulic conductivity of 6.8 feet per day was calculated based on Phase I RI slug testing. Using the same gradient and porosity, a flow velocity of 0.063 foot per day was calculated for the alluvium.

2.5.1.2 Site 3 – Area A Downstream Watercourses and OBDA and Site 14 – OBDANE

Sites 3 and 14 are located in the same northern valley as Sites 2A and 2B. Site 3 receives surface water and groundwater recharge from Sites 2A, 2B, 7, and 14, and surrounding areas. The streams within Site 3 convey the water to the Thames River. Site 14 is located adjacent to Stream 3.

The geology of Sites 3 and 14 consists of overburden deposits overlying metamorphic bedrock. The overburden consists of silty sand and gravel and is mapped as stratified drift of former meltwater streams [United States Geological Survey (USGS, 1960)]. Although these are natural materials, they have most likely been reworked in the area of the golf course. In general, the overburden thickness increases from the valley margins to the center of the valley and from southeast to northwest along the valley axis. The overburden thickness is less than 5 feet at well 2DMW10D and less than 15 feet at wells 2DMW25D and 2DMW27D. The overburden is thicker in the golf course area, and bedrock was not encountered in the 50-foot boring at well 2DMW26D. Well locations are shown on Figure 2-4.

The surface of the bedrock at Sites 3 and 14, identified as the Mamacoke Formation, slopes from the northern and central bedrock highs that surround the area toward the northwest-trending valley. There appears to be a localized bedrock high at well 2DMW15D. The depth to bedrock is only 4 feet at this location, and the bedrock surface elevation is higher than was encountered in surrounding boreholes. This local bedrock high corresponds to a local topographic high within the valley. The boring logs for monitoring wells installed near OBDA indicate that the overburden locally consists of sand and boulders. The depth to bedrock at Site 3 was approximately 15 feet. There are bedrock exposures upslope of Site 14, and bedrock was encountered at the site at depths of 12 feet below ground surface (bgs).

Groundwater is present in both the overburden and bedrock underlying Sites 3 and 14. The saturated thickness of the overburden ranges from a few feet along the valley margins to greater than 40 feet in the central portion of the stream valley. Depth to groundwater ranges from a few feet in the eastern portion to over 15 feet in the golf course area to the west. Figures 2-10 and 2-11 show regional groundwater flow patterns across Sites 3 and 14 in the shallow overburden and bedrock, respectively, based on the August 2000 round of water-level measurements taken during the BGOURI. Figures 2-12 and 2-13 show the local groundwater flow patterns in the shallow overburden and bedrock, respectively, based on October 2002 measurements. The figures show that groundwater flows from topographic/bedrock highs and Site 2B to Site 3. From the downstream area, groundwater flows west toward and discharges into the Thames River. Vertical gradients between the overburden and bedrock are mixed across Site 3 but are predominantly upward. A downward gradient was observed at well cluster 2DMW24S/D, and upward head differentials were observed at well clusters 2DMW16S/D, 2DMW25S/D, and 2DMW28S/D.

Along the valley margins and near the Site 2B dike, local groundwater flow gradients are steep. As the bedrock slope flattens and the overburden thickens, hydraulic gradients also flatten. The overall hydraulic gradient in the direction of groundwater flow across Site 3 within both the overburden and bedrock is approximately 0.024 based on the BGOURI 2000 water level data. In both the overburden and bedrock, the hydraulic gradient steepens slightly toward the Thames River.

Slug test results for Site 3 alluvium and bedrock wells, summarized in the BGOURI (TtNUS, 2002a), show that the average horizontal hydraulic conductivity of the alluvium is approximately 5.3 feet per day and that the average horizontal bulk hydraulic conductivity of the bedrock is approximately 1.8 feet per day. Using a flow gradient of 0.024, a hydraulic conductivity of 5.3 feet per day, and a measured porosity of 0.33, the average groundwater flow velocity through the predominantly sandy alluvial materials across Site 3 was calculated to be approximately 0.4 foot per day.

2.5.1.3 Site 7 – Torpedo Shops

Figure 2-4 shows the topography and surface features of Site 7. Site 7 is surrounded on the north and east by an exposed bedrock cliff. The cliff is the result of quarry activity along the northern bedrock high. The ground surface slopes gently to the southwest, and there is an earthen berm along the eastern boundary of the site. Surface water runoff from Site 7 flows southwestward to drainage swales and storm sewers located on the southern side of Buildings 325 and 450. Runoff contained by the berm and the storm sewer system drains through culverts under Triton Road into Site 3 (Stream 5) and eventually into the Thames River.

The geology of Site 7 consists of a southwestward-thickening wedge of overburden materials overlying metamorphic bedrock. Surficial deposits underlying Site 7 consist of fill material that varies in thickness from 2 to 10 feet and consists primarily of sand and gravel. The fill either lies directly on bedrock (in the northeastern portion of the site) or is underlain by up to 30 feet of silty sand (along the southwestern edge of the site). This area has a history of quarrying and filling, and the silty sand is natural alluvium. The bedrock in this area has been identified as the Mamcoke Formation. In the northeastern portion of the site, the bedrock surface is relatively flat and has a mild slope toward the southwest. The bedrock surface between groundwater monitoring wells 7MW1D and 7MW7S slopes at a grade of approximately 2 percent. The bedrock surface in this area has been altered by quarry activity. Overburden thickness is typically less than 6 feet in this area. Southwest of groundwater monitoring wells 7MW7S and 7MW2D and southeast of test boring 7TB10, the bedrock slopes to the west and southwest more steeply. The bedrock surface between groundwater monitoring wells 7MW7S and 7MW3D slopes at a steeper grade of approximately 14 percent. The overburden thickness increases to 30 to 40 feet in this area.

Groundwater was encountered in both the overburden and bedrock underlying Site 7. Depths to groundwater average less than 10 feet across the site. Within the overburden, the water table was generally encountered near the fill/alluvium interface at locations where both units were present. Figure 2-10 shows the overburden groundwater flow pattern across the Site 7 area based on August 2000 water level data. The figure shows that the general direction of shallow groundwater flow is to the west-southwest toward Site 3. Groundwater flow directions in the shallow bedrock, as determined during the BGOURI, are to the west and southwest (Figure 2-11). In the overburden, the hydraulic gradient across the site is approximately 0.02. Within the bedrock, the flow gradient appears to be slightly lower at 0.015.

Downward vertical gradients were consistently observed at Site 7. Groundwater monitoring well clusters 7MW2S/2D (alluvium/bedrock), 7MW3S/3D (combined fill and alluvium/deep alluvium), and 7MW5S/5D (combined overburden and bedrock/deeper bedrock) all had downward vertical gradients, indicating that the Site 7 area is a local recharge area for groundwater.

Slug tests were performed in three alluvium and two bedrock wells at Site 7 over the course of the various RI field investigations. The estimated site-specific average hydraulic conductivity for the alluvium, based on slug test results, is 11.4 feet per day. Using a hydraulic gradient of 0.02 and a measured porosity of 0.37, the estimated groundwater seepage velocity in the alluvium at the site is 0.62 foot per day.

2.5.1.4 Site 15 – Spent Acid Storage and Disposal Area

Figure 2-7 shows the surface features of Site 15. The entire area is covered with concrete or bituminous pavement. The site is located southwest of the central bedrock high, which narrowly extends to the

south. The ground surface in the vicinity of the site and southwest is relatively flat. Surface water runoff from this site is collected by a storm sewer system that passes through the Tank Farm (Site 23) and Goss Cove Landfill (Site 8) sites and eventually discharges to the Thames River.

Geologic conditions at Site 15 consist of variable thicknesses of fill and natural alluvial deposits overlying metamorphic bedrock. The overburden at Site 15 consists primarily of silty sand alluvium. Boring logs indicate that in some intervals, there are traces of clay and in others, there are traces of gravel and rock fragments. Site 15 has been mapped as stratified drift deposited by glacial meltwater streams (USGS, 1960). Minor thicknesses of fill may be present overlying the silty sand in some areas of the site. The borings for wells 15MW1D and 15MW4S encountered silt layers of 26- and 24-foot thicknesses, respectively, beneath the silty sand interval. These deposits are also most likely stratified drift.

The bedrock surface slopes to the southwest across the site. Monitoring well 15MW1D was drilled to a depth of 46.5 feet bgs, where gneiss fragments of the Mamacoke Formation were encountered. Monitoring well 15MW4S was drilled to a total depth of 43 feet bgs. Bedrock was not positively identified in this boring; however, auger refusal was reached, suggesting that the bedrock surface may have been encountered. Northeast of the site along Rasher Avenue, bedrock crops out at ground surface.

During historical and recent investigations at this site, groundwater was encountered in the alluvium at depths of less than 10 feet bgs. Most overburden groundwater flow is expected to be through the silty sand layer, with the underlying silt deposit acting as a semi-confining unit. The groundwater generally flows to the south-southwest. There is a downward vertical gradient at the 15MW1 well cluster.

Water level measurements were taken in Site 15 monitoring wells during the BGOURI in 2000. The elevations were used in conjunction with water level data from other sites to create regional shallow overburden and bedrock potentiometric surface maps (see Figures 2-14 and 2-15, respectively). Water level measurements were also taken in Site 15 monitoring wells during a DGI in 2002. These data were used to prepare a site-specific potentiometric surface map for the shallow overburden groundwater at Site 15 (see Figure 2-16). Based on Figures 2-14 and 2-16, groundwater flow direction (southwest) in the shallow overburden groundwater was consistent during both rounds.

Based on information presented in the BGOURI Report (TtNUS, 2002a), the hydraulic gradient in shallow overburden across the site is approximately 0.024. During Phase II RI field work, slug tests were performed in wells 15MW1S and 15MW3S. The geometric mean of the calculated hydraulic conductivities is 0.76 feet per day. Assuming a porosity of 0.30, the estimated groundwater seepage velocity at Site 15 is 0.06 feet per day.

2.5.1.5 Site 18 – Solvent Storage Area, Building 33

Figure 2-8 shows the surface features of Site 18, located north of Site 15 and Site 23. A steep embankment exists on the northern and eastern sides of Building 33. The embankment slopes at an approximate gradient of 50 percent toward the south and west. The gradient flattens to approximately 5 percent on the southern and eastern sides of Building 33. Surface water runoff from this site is collected by a storm sewer system that passes through Site 23 and Site 8 and eventually discharges to the Thames River.

The SCS Soils Map (SCS, 1983) classifies the soil on the southern and western sides of Building 33 as Urban land. Upgradient of the site (north and east), bedrock exposures (Hollis-Charlton-Rock outcrop complex) are prevalent as the central bedrock high extends toward the south. The soils overlying the bedrock range from very stony fine sandy loam to gravelly loam.

Minimal subsurface investigation work has been performed at Site 18. The site has a veneer of silty sand overlying shallow metamorphic bedrock. The sand is fine to medium grained and contains trace to some gravel and rock fragments.

Groundwater levels were measured in temporary wells 18TW2 and 18TW4 on June 14, 2000. The elevations associated with these measurements are presented on Figure 2-8. The general direction of groundwater flow in the shallow overburden at Site 18 is to the south. Groundwater from this site eventually discharges to the Thames River. The saturated thickness of the overburden at the site varies from approximately 1 foot to greater than 5 feet.

2.5.1.6 Site 20 – Area A Weapons Center

Site 20 is located along the southern side of the northern topographic and bedrock high (see Figure 2-9). The ground surface generally slopes from the northern bedrock high across the site to the south toward the Site 2B. The ground surface across Site 20 was altered (flattened) when the bedrock was blasted during construction of Building 524. To the west and southwest, the ground surface slopes to a ravine (Site 3) and toward Site 14.

Two drainage culverts (one along the northwestern side and one along the southeastern side of the site) collect runoff from the surrounding hillsides and from Site 20 and discharge it to Site 2B. The drainage culvert along the northwestern side eventually discharges to a storm sewer that passes along the southern side of the site and discharges into Site 2B. The drainage culvert along the southeastern side collects runoff from the hillside north of the site and continues along the southeastern side of the site,

eventually discharging to another area of Site 2B. Site 2B discharges to Site 3 and subsequently into the Thames River. Water typically flows in these drainage culverts immediately following precipitation events.

The overburden materials at Site 20 consist of 4 to 16 feet of coarse sand, gravel, and rock fill underlain by up to 17 feet of fine-grained dredge spoils. Test borings showed that 4 to 8 feet of fill material rests directly on bedrock (Mamacoke Formation) across Site 20. The overburden thickness generally increases to the south and east, toward the Site 2B.

The bedrock surface generally slopes to the southwest across the site, toward the valley occupied by Site 2. Bedrock elevations in the Site 20 area indicate that the bedrock surface does not slope uniformly and that localized bedrock surface depression(s) are present. The depressions are most likely the result of the blasting activities that occurred during the construction of Building 524.

Groundwater is present in both the overburden and bedrock underlying Site 20. The saturated thickness of the overburden deposits is variable, ranging up to 25 feet or more. Overburden groundwater is primarily found within the dredge spoil materials, and only the lowermost few feet of the coarser-grained fill deposits are saturated. Shallow overburden and bedrock groundwater contours for Site 20 and nearby areas, based on August 2000 water levels, are shown on Figures 2-10 and 2-11, respectively. Groundwater in both the overburden and bedrock at Site 20 flows to the west and southwest. Shallow overburden groundwater contours at Site 20 generated from water levels measured during the October 2002 DGI are shown on Figure 2-17. The site-specific contours and groundwater flow directions are generally similar to those measured in 2000.

The hydraulic gradient in the shallow overburden varies considerably across Site 20; it is steeper in the area of Building 524 and flatter at the storage bunkers near the Area A Wetlands. The overall groundwater flow gradient in the overburden, based on 2000 water level data, averages approximately 0.04. Assuming an average horizontal hydraulic conductivity in dredge spoil of 0.017 foot per day and in alluvium/fill of 2.0 feet per day (based on hydraulic testing completed at Site 2A) and a porosity of 0.30, the horizontal seepage velocity for overburden groundwater in this area ranges from approximately 0.0023 to 0.27 foot per day.

2.5.1.7 Site 9 – Waste OT-5 and Site 23 – Tank Farm

Site 23, within which Site 9 is located, is in the southern northwest-trending valley and is bordered on the north and south by bedrock highs. In this valley, the ground slopes mildly from approximately 50 feet above mean sea level in the eastern portion to near sea level along the Thames River. A former topographic depression at the former Crystal Lake between Tang Avenue and Crystal Lake Road was filled during construction of the Tank Farm. Figure 2-6 shows surface topography at the Tank Farm.

Due to the cover material and topography of the Tank Farm, a majority of the rain that falls on this site will infiltrate into the ground. Groundwater at this site is collected by a dewatering system. Surface runoff from some portions of the site is collected by a stormwater collection system. Both groundwater and surface water collected by the systems discharge to the Thames River at the Goss Cove Landfill.

The predominant overburden materials observed during the BGOURI at Site 23 were fill and reworked soil. The soils were generally silty, fine- to medium-textured sands with trace amounts of rock fragments. Below the fill deposits are natural alluvium consisting primarily of silty sand. The thickness of the alluvium is variable. In the western portion of the site, the alluvium extends to a depth of over 50 feet. The depth to bedrock encountered during the 1998 hydrogeologic investigation varied from 15 to 58 feet. The greatest depths to bedrock were encountered along the eastern and western site boundaries. The shallowest depths to bedrock were encountered in the central portion of the site, along its northern and southern boundaries.

Groundwater is present in both the overburden and bedrock underlying Site 23. Shallow overburden groundwater generally flows into the central area of Site 23 then west toward the Thames River. The flow pattern reflects the presence of the tank underdrain system and groundwater collection system in this area, both of which act as groundwater sinks (collection points). The shallow groundwater flow gradient varies widely across the site but averages about 0.01. Bedrock groundwater flow is generally to the west and southwest. The Tank Farm underdrains and groundwater collection system that have a significant influence on shallow groundwater flow patterns do not affect bedrock groundwater flow directions to any significant degree. The flow gradient in the bedrock averages about 0.014 across Site 23. Figures 4-14 and 4-15 show groundwater flow patterns in the shallow overburden across Site 23, based August 2000 of water-level measurements.

The average overburden hydraulic conductivities based on slug testing during the BGOURI was 2.3 feet per day. For bedrock wells, the hydraulic conductivities were 0.73 feet per day and 652 feet per day. The large range is typical of the difference between highly transmissive bedrock fractures and less transmissive fractures. Using an average gradient of 0.01, an average hydraulic conductivity of 2.3 feet per day, and an assumed porosity of 0.3, the average groundwater flow velocity in the overburden is approximately 0.8 foot per day.

2.5.2 Nature and Extent of Contamination

The Navy conducted various field investigations at Sites 2A, 2B, 3, 9, 7, 14, 15, 20, and 23 from 1990 to the present to assess the nature and extent of groundwater contamination. The investigations at Sites 2A, 2B, 3, 7, 20, and 23 focused on groundwater present in the overburden and bedrock, and the

investigations at Sites 9, 14, 15, and 18 only focused on groundwater in the overburden. Sites 2A and 2B are located hydraulically upgradient of Site 3, Sites 14 and 20 are hydraulically upgradient of Sites 3 and 7, and Sites 15 and 18 are hydraulically upgradient of Sites 9 and 23.

Only one round of investigation was conducted at Site 18 to assess the nature and extent of contamination. The investigation focused on groundwater present in the overburden.

2.5.2.1 Sites 2A and 2B

Phase II RI

For Site 2A, the Phase II RI concluded that shallow groundwater contamination (i.e., VOCs, PCBs, and inorganics) exists at the site and recommended that institutional controls including groundwater monitoring and use restrictions be implemented. For Site 2B, the Phase II RI concluded that the site may pose a risk to construction workers due to potential exposure to manganese in groundwater and recommended that an FS be conducted to evaluate a limited action alternative that included groundwater monitoring and use restrictions.

BGOURI

Six VOCs were detected in groundwater samples collected during the BGOURI. Several of the VOCs were detected during previous soil and groundwater sampling events. Acetone was the only VOC COPC identified at Site 2. In general, acetone concentrations were less than 10 µg/L, with the exception of a concentration of 120 µg/L in well 2WMW39DS. Acetone is also known to be a common laboratory artifact.

Three SVOCs were detected in groundwater samples collected during the BGOURI. None of the detected concentrations exceeded any of the relevant screening criteria. One pesticide, 4,4'-DDD, was detected in a single groundwater sample. High dissolved solids were detected in the groundwater sample, and it is likely that the DDD was bound to the solids.

Fifteen metals were detected in unfiltered groundwater samples, and 13 metals were detected in filtered groundwater samples. Arsenic, barium, and mercury were the only metals identified as COPCs. Exceedances of background levels for these metals were sporadic; only one well (2WGW47DS) had concentrations of more than one metal in excess of background levels. Concentrations of the other detected metals were less than screening criteria. In general, metals concentrations were lower in the BGOURI than in previous investigations. This result was generally expected because only downgradient monitoring wells and not monitoring wells within the Area A Landfill were sampled during the BGOURI.

The BGOURI report recommended that the groundwater monitoring program being conducted in accordance with the OU1 ROD be continued to gather data to evaluate long-term trends in contaminant concentrations and that the decision about whether to proceed to an FS should be made after sufficient data were collected and evaluated.

Annual Groundwater Monitoring

Eight years of groundwater monitoring under the OU1 ROD have been completed. Year 7 (2006) results, the most recent available, indicate that copper was the only contaminant detected in groundwater at concentrations in excess of criteria, and the well in which it was detected was a reference well not a downgradient well. Based on the results of the monitoring program to date, the landfill cap is working properly and significant contaminant migration from the landfill to groundwater is not occurring. Also based on monitoring results, it was decided that an FS was not necessary for this site. Figure 2-18 presents the groundwater exceedance detected during Year 7 sampling.

2.5.2.2 Sites 3 and 14

Groundwater at Sites 3 and 14 was investigated independently and collectively throughout the various investigations. The nature and extent of contamination found during each investigation is discussed below.

Phase II RI

Site 3 - Overburden

Seven VOCs, including six halogenated aliphatics and benzene, were detected in groundwater samples collected from overburden wells at Site 3. Each VOC was detected in from 1 to 3 of 25 samples. Most of the VOCs were detected in well 2DMW29S, located along Triton Road in the north-central portion of the site. Maximum concentrations of total 1,2-dichloroethene [28 micrograms per liter (µg/L)], bromodichloromethane (2 µg/L), chloroform (12 µg/L), methylene chloride (11 µg/L), and vinyl chloride (VC) (130 µg/L) were detected in samples from this well. None of these chemicals were identified in the surface water samples collected from the adjacent drainageway (Stream 5) along Triton Road. The source(s) of this groundwater contamination is not known.

Two phthalate esters (plasticizers that are common field and laboratory contaminants) and benzoic acid were each detected in from one to three of the groundwater samples collected from overburden wells.

Twenty-three metals were detected in unfiltered groundwater samples collected from overburden wells, and 19 metals were detected in associated filtered groundwater samples. Greater than two-thirds of the

maximum concentrations of metals were associated with samples collected from overburden wells 2DMW30S and 3MW12S. Notable results for metals included maximum concentrations of aluminum (97,400 µg/L), arsenic (23.9 µg/L), barium (835 µg/L), manganese (6,710 µg/L), vanadium (229 µg/L), and zinc (800 µg/L).

Site 3 - Bedrock

Five halogenated aliphatics (1,1,2,2-tetrachloroethane, total 1,2-dichloroethene, chloroform, methylene chloride, and TCE) were detected in groundwater samples collected from bedrock wells at Site 3. Each VOC was detected in from 1 to 4 of the 25 groundwater samples. TCE concentrations ranged from 1 µg/L to 17 µg/L. Maximum concentrations of 1,1,2,2-tetrachloroethane, total 1,2-dichloroethene, and TCE were detected during the Phase I RI in the groundwater sample collected from well 2DMW16D, located approximately 125 feet southeast of North Lake.

Eleven semivolatile organic compounds (SVOCs) were also detected in groundwater samples from Site 3 bedrock wells. Six PAHs, ranging in concentration from 1 to 4 µg/L, were detected in the groundwater sample from well 3MW12D collected during Round 1 of the Phase II RI. In addition, bis(2-ethylhexyl) phthalate was detected in five groundwater samples at concentrations ranging from 2 to 20 µg/L. Two additional phthalates, benzoic acid, and phenol were each detected in one or two groundwater samples at concentrations ranging from 0.5 to 5 µg/L. As previously noted, phthalates are considered to be common laboratory contaminants.

Twenty-two metals were detected in unfiltered groundwater samples from bedrock wells, and 18 metals were detected in associated filtered groundwater samples. Approximately 42 percent of the maximum concentrations of metals were associated with samples from bedrock well 3MW12D.

Site 14 - Overburden

One VOC (carbon disulfide) and one SVOC [bis(2-ethylhexyl) phthalate] were detected in the two groundwater samples collected from well 14MW1S. Both chemicals were detected at an estimated concentration of 1 µg/L. The results indicate that Site 14 is not a significant source of organic groundwater contamination.

Eleven metals were detected in unfiltered Site 14 groundwater samples, and 12 metals were detected in associated filtered groundwater samples. With the exception of aluminum (at 171 µg/L in unfiltered sample 14GW1S only), filtered and unfiltered results were at the same order of magnitude. Maximum concentrations of arsenic in filtered samples and of boron and cobalt in unfiltered samples exceeded

respective concentrations of these metals detected in unfiltered groundwater samples from off-site residential wells.

BGOURI

Sites 3 and 14 - Overburden

Four VOCs (chloroform, cis-1,2-dichloroethene, TCE, and VC) were detected in one or more of the 10 groundwater samples collected from the overburden aquifer. Detected concentrations of these VOCs ranged from 1.71 µg/L (cis-1,2-dichloroethene) to 31.3 µg/L (VC) and were less than in samples collected during previous investigations. Acetone was detected at estimated concentrations of 27.8 and 28.9 µg/L in two samples collected from temporary wells installed in the overburden aquifer. VC (4.65 µg/L) and cis-1,2-dichloroethene (1.71 µg/L) were detected in one groundwater sample collected from a temporary well.

Several PAHs and 4-methylphenol were the only SVOCs detected in groundwater at Site 3. Concentrations of most of these SVOCs were low, ranging from 0.03 µg/L [benzo(k)fluoranthene] to 2 µg/L (4-methylphenol). With the exception of fluoranthene, which was detected in three groundwater samples, each SVOC was detected in only one groundwater sample. PAHs and 4-methylphenol were not detected in overburden groundwater samples collected during previous investigations.

Trace levels of 1,1-dichloro-2,2-bis(4-chlorophenyl)ethane (DDD) (0.019 µg/L) and 1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane (DDT) (0.034 µg/L) were detected in overburden well 2DMW30S. High levels of total suspended solids were measured in this well and are the likely cause of the detections of DDD and DDT in groundwater. Pesticides were not detected in overburden groundwater samples collected during previous investigations.

Fifteen metals were detected in unfiltered overburden groundwater samples, and nine metals were detected in filtered overburden groundwater samples. Concentrations of metals in filtered and unfiltered samples were relatively similar (i.e., at the same order of magnitude). In general, the detected concentrations of metals were low. Concentrations of all metals were lower in groundwater samples collected during the BGOURI than in samples collected during previous investigations.

Site 3 - Bedrock

Three VOCs (chloroform, cis-1,2-dichloroethene, and TCE) were detected in nine groundwater samples collected from the bedrock aquifer. TCE concentrations were low, ranging from 1.88 to 8.76 µg/L. In general, VOCs were detected infrequently in bedrock groundwater during the BGOURI. Chloroform,

1,2-dichloroethene (total), and TCE were also detected in bedrock groundwater samples collected during previous investigations. Concentrations of 1,2-dichloroethene and TCE detected during the BGOURI were less than concentrations detected during previous investigations. No SVOCs, pesticides, or PCBs were detected in groundwater samples collected from the bedrock aquifer.

Fourteen metals were detected in unfiltered bedrock groundwater samples, and eight metals were detected in filtered bedrock groundwater samples. Reported concentrations of metals in filtered and unfiltered samples were relatively similar (i.e., at the same order of magnitude). In general, the detected concentrations of metals were low. Concentrations of all metals were lower in groundwater samples collected during the BGOURI than in samples collected during previous investigations, with the exception of silver and zinc.

BGOURI Update/FS

Eight VOCs were detected in Site 3 groundwater samples collected during the DGI. Data collected during the DGI were used to evaluate the nature and extent of contamination associated with Site 3-NSA and to confirm the nature and extent of groundwater contamination detected during previous investigations. 1,1,2-Trichloroethane, carbon disulfide, toluene, and trans-1,2-dichloroethene were detected during the DGI but were not detected during the BGOURI. These VOCs were detected infrequently (less than 25 percent of the samples) and at relatively low concentrations (less than 2 µg/L). The compounds cis-1,2-dichloroethene, TCE , and VC were detected at lower concentrations (less than 3 µg/L) during the DGI than the BGOURI (less than 32 µg/L). All of these wells are located along Stream 5 in the northern portion of Site 3.

Chlorinated VOCs have been consistently detected in several Site 3 wells since the Phase II RI. It appears that VOC contamination (TCE) was originally released in the Site 7 area (leach fields) and migrated to Site 3.

Seven SVOCs, all PAHs, were infrequently detected in groundwater samples collected during the DGI. No PAHs were detected in the samples collected from permanent monitoring wells, and all of the maximum concentrations were less than 1 µg/L in one temporary well. The source of the detected PAHs may be the PAH-contaminated soil (i.e., suspended solids in the temporary well) or the petroleum hydrocarbon contamination associated with the NSA.

The only pesticides detected in groundwater were alpha- and beta-BHC, and they were detected only in the sample from one temporary well (same well as the PAH detections). These pesticides were detected at low concentrations in soil samples, but it is unlikely that they have leached at significant dissolved

concentrations to groundwater. It is more likely that these groundwater detections were the result of suspended solids incorporated into the groundwater sample during sampling.

Thirteen inorganics were detected in unfiltered samples collected during the DGI, but only eight inorganics were detected in filtered samples. It is likely that elevated inorganics concentrations in unfiltered samples are related to suspended solids incorporated into groundwater samples from temporary wells. Overall, DGI results indicate that Site 3 - NSA is not a significant source of inorganic contamination at Site 3.

Quarterly Groundwater Monitoring

The first year of quarterly groundwater monitoring at Site 3 was conducted from May 2006 to April 2007 (TtNUS, 2007) in accordance with the Work Plan for Remedial Action at Sites 3 and 7 (TtNUS, 2006b) and Operation and Maintenance (O&M) Manual for IR Program Sites (TtNUS, 2006a). Site 3 COCs, as presented in the Remedial Action Work Plan, are TCE and VC. Groundwater samples were collected from nine wells at Site 3 during quarterly sampling. No COCs were detected in six of the nine wells sampled during Year 1 of the monitoring program. Year 1 exceedances of remedial goals (RGs) included TCE in 3MW16D during the first quarter and in 2DMW16D during all four quarters and VC in 2DMW29S during the second and fourth quarters. Wells 3MW16D and 2DMW29S are located near Stream 5 and are downgradient of the former Site 7 leach fields. The TCE concentration in 3MW16D during the first quarter was 5.1 µg/L, slightly greater than the RG of 5 µg/L. VC concentrations in 2DMW29S have decreased from a maximum of 130 µg/L in 1994 to 4 µg/L during the last sampling round (slightly greater than the RG of 1.6 µg/L). Well 2DMW16D is located on the southern side of Site 3 and is not downgradient of the former Site 7 leach fields. It appears that the Area A Landfill or an unknown upgradient area of contamination is the source of TCE in this well. TCE concentrations in 2DMW16D have decreased from a maximum of 17 µg/L in 1991 to a maximum of 7 µg/L during Year 1 monitoring. Based on the results of Year 1 monitoring, no changes to the Site 3 monitoring program were recommended in the Year 1 Annual Groundwater Monitoring Report. Tables 2-1 and 2-2 present Year 1 groundwater monitoring data from Sites 3 and 7, respectively, and Figure 2-19 presents exceedances detected during the first year of monitoring.

2.5.2.3 Site 7

Historical Investigations - Combined Results of Phase I and II RIs

Overburden

Eight VOCs, including six chlorinated aliphatics, 2-butanone, and carbon disulfide were detected in groundwater samples collected from Site 7 overburden wells. 1,1,1-Trichloroethane and

1,1-dichloroethane were each detected in 6 of 20 groundwater samples, at concentrations ranging from 2 µg/L to 42 µg/L. 1,1-Dichloroethene was detected in four groundwater samples at concentrations ranging from 1 µg/L to 2 µg/L. The remaining VOCs were detected in one or two samples at concentrations ranging from 1 µg/L to 10 µg/L. Maximum concentrations of all VOCs except 2-butanone, chlorobenzene (CB), and methylene chloride were associated with the sample collected from well 7MW3S, located west of Building 325 in the southern leach field.

Thirteen SVOCs, including six PAHs, three phthalates, 1,4-dichlorobenzene (1,4-DCB), benzoic acid, dibenzofuran, and phenol, were detected in the 20 groundwater samples collected from overburden wells at Site 7. Benzoic acid and di-n-butyl phthalate were detected in six and four samples, respectively. The remaining SVOCs were each detected in only 1 or 2 of 20 samples. With the exception of bis(2-ethylhexyl) phthalate, which was detected in a single groundwater sample at a concentration of 380 µg/L, all SVOC concentrations ranged from 0.5 µg/L to 9 µg/L. Maximum concentrations of eight SVOCs were associated with groundwater samples collected from well 7MW8S, located along Triton Road in the western portion of the site.

Twenty-two metals were detected in unfiltered groundwater samples collected from overburden wells, and 15 metals were detected in the corresponding filtered groundwater samples. In general, maximum concentrations of metals in unfiltered and filtered samples were within the same order of magnitude. Close to half of the maximum concentrations of metals were associated with groundwater samples collected from well 7MW3D, located near Triton Road and west of the southern leach field.

Analyses for oil and grease were performed on four of the groundwater samples. The sample from well 7MW3D had an oil and grease a concentration of 600 µg/L. TPH analyses were performed for nine of the groundwater samples collected from overburden wells. TPH was detected in two samples (both collected from well 7MW8S) at concentrations of 700 µg/L and 1,200 µg/L. This well is located along Triton Road, downgradient of Buildings 325, 450, and 477.

Bedrock

Minimal organic contamination was detected in groundwater samples collected from Site 7 bedrock wells. 1,1,1-Trichloroethane (2 µg/L), methylene chloride (1 µg/L), benzoic acid (0.7 µg/L), and phenol (0.8 µg/L) were detected in samples collected from well 7MW5D. 4-Methyl-2-pentanone, methylene chloride, and total xylenes were detected in one well each. No other VOCs, SVOCs, pesticides, or PCBs were detected.

Twenty-four metals were detected in unfiltered groundwater samples from bedrock wells, and 14 metals were detected in the corresponding filtered groundwater samples. Maximum concentrations of barium,

copper, iron, lead, and zinc in unfiltered samples were more than five times greater than maximum concentrations of respective concentrations in filtered samples. This indicates that the concentrations in unfiltered samples may be caused by the presence of suspended sediments and may not actually represent contamination of the groundwater. More than half of the maximum concentrations of metals were associated with groundwater samples collected from well 7MW5D, located near the southwestern corner of Building 450. In addition, several maximum concentrations were associated with groundwater samples collected from well 7MW4S, located near the southeastern corner of Building 325.

BGOURI

Overburden – Temporary Wells

The VOCs 1,4-DCB, benzene, and CB were detected in overburden temporary monitoring wells. 1,4-DCB concentrations ranged from 1.83 to 90.5 µg/L, benzene was detected in one sample at 2 µg/L, and CB was detected at concentrations of 6.66 µg/L and 165 µg/L. Based on the locations of the wells (see Figure 2-5), it is likely that these detections are related to the septic tank located along the western side of Building 325. The septic system is no longer used, but the disposition of the tank is not known.

Three of the 10 temporary monitoring wells were analyzed for SVOCs. The only SVOC detected in temporary monitoring wells was bis(2-ethylhexyl) phthalate at concentrations of 44 and 49 µg/L.

Seventeen metals were detected in the groundwater samples collected from Site 7 temporary monitoring wells. Maximum detected concentrations were all detected in one well, and arsenic, barium, chromium, cobalt, copper, nickel, silver, vanadium, and zinc were detected only in this well. Calcium, magnesium, manganese, potassium, and sodium were detected in all three samples. Aluminum, iron, and lead were detected in two of three samples. Of these detected metals, aluminum, arsenic, barium, chromium, iron, lead, nickel, silver, vanadium, and zinc were detected at concentrations in excess of background concentrations. The total suspended solids content in sample S7TW0901 was two orders of magnitude higher than in the other two samples; this may account for the elevated metals concentrations in this sample.

Overburden – Permanent Monitoring Wells

The VOCs 1,3-DCB, 1,4-DCB, and TCE were detected in permanent overburden monitoring wells at Site 7. 1,3-DCB and 1,4-DCB were detected only in one well at 2 µg/L. TCE was detected in four wells at concentrations ranging from 1.93 to 23 µg/L. The SVOCs detected in permanent monitoring wells were bis(2-ethylhexyl) phthalate, fluorene, hexachlorobenzene (HCB), and phenanthrene. Phenanthrene and bis(2-ethylhexyl) phthalate were detected in one sample at concentrations of 6.5 and 190 µg/L,

respectively. HCB was detected in one sample at 3 µg/L. Fluorene was detected in two samples at 0.26 and 6.5 µg/L, respectively.

Seventeen inorganics were detected in unfiltered groundwater samples from Site 7 permanent bedrock monitoring wells. Maximum detected concentrations were scattered among the 13 wells. Arsenic, cadmium, chromium, selenium, and vanadium were detected in only 1 of 13 samples. Aluminum, copper, iron, and lead were detected in 4 to 5 of 13 samples. Barium, cobalt, and zinc were detected in 8 of 13 samples. Manganese was detected in 11 of 13 samples. Calcium, magnesium, potassium, and sodium were detected in all 13 samples. Arsenic, cadmium, lead, selenium, and zinc were detected at concentrations in excess of background concentrations. Arsenic was detected at 2.9 µg/L, in excess of the risk-based COPC screening level (Region 9 PRG) but not in excess of the CTDEP surface water protection criterion (SWPC) (CTDEP, 1996). Zinc, detected at a maximum concentration of 194 µg/L, was the only analyte present at a concentration in excess of CTDEP pollutant mobility criteria.

Bedrock – Permanent Wells

TCE was the only VOC detected in Site 7 bedrock groundwater samples collected during the BGOURI. TCE was detected in three samples at concentrations ranging from 1.54 to 7.58 µg/L, all in excess of the risk-based COPC screening level (Region 9 PRG) but less than the CTDEP SWPC.

Eleven metals were detected in unfiltered bedrock groundwater samples, with the majority of maximum concentrations detected in two samples. Calcium, magnesium, potassium, and sodium were the only metals detected in all four bedrock groundwater samples. Copper and nickel were only detected in one sample. The remaining detected metals were detected in two to three of the four samples collected. The concentrations of lead, nickel, and zinc were in excess of background concentrations.

Quarterly Groundwater Monitoring

The first year of quarterly groundwater monitoring at Site 7 was conducted from May 2006 to April 2007 (TtNUS, 2007) in accordance with the Work Plan for Remedial Action at Sites 3 and 7 (TtNUS, 2006b) and O&M Manual for IR Program Sites (TtNUS, 2006a). Groundwater samples were collected from eight wells at Site 7 during quarterly sampling. Site 7 COCs, as presented in the Remedial Action Work Plan, are 1,4-DCB, benzene, CB, HCB, and TCE. No COCs were detected at concentrations greater than RGs during Year 1 monitoring. Based on the results of Year 1 monitoring, no changes to the Site 7 monitoring program were recommended in the Year 1 Annual Groundwater Monitoring Report. Tables 2-1 and 2-2 present Year 1 groundwater monitoring data from Sites 3 and 7, respectively, and Figure 2-19 presents exceedances detected during the first year of monitoring at Sites 3 and 7.

2.5.2.4 Site 15

Phase II RI

Ten groundwater samples were collected from five overburden wells at Site 15 during Rounds 1 and 2 of the Phase II RI in 1994. Carbon disulfide was detected at a concentration of 3 µg/L in one well during Round 1 of the Phase II RI. No other VOCs were detected. Five SVOCs [1,4-DCB, bis(2-ethylhexyl) phthalate, di-n-butyl phthalate, naphthalene, and phenanthrene] were detected in groundwater samples. The two phthalates, plasticizers that are common field and laboratory contaminants, were each detected in 4 of 10 samples. The remaining SVOCs were each detected in 1 or 2 of 10 samples. Concentrations of bis(2-ethylhexyl) phthalate ranged from 0.6 to 45 µg/L. Concentrations of the remaining SVOCs ranged from 0.5 to 1 µg/L. The pesticide heptachlor was also detected at a concentration of 0.54 µg/L.

Twenty-one metals were detected in unfiltered groundwater samples, and 17 metals were detected in corresponding filtered groundwater samples. A majority of the maximum concentrations were associated with samples collected from wells 15MW3S and 15MW2S, located downgradient and upgradient, respectively, of Site 15. Notable results reported for Site 15 groundwater samples include maximum concentrations of manganese in both filtered and unfiltered groundwater samples at 3,080 µg/L and maximum concentrations of zinc in filtered and unfiltered groundwater samples at 450 µg/L and 453 µg/L, respectively. The maximum lead concentration in one unfiltered groundwater sample from 15MW3S (21.2 µg/L) was significantly higher than subsequent filtered (2 µg/L) and unfiltered (4.4 µg/L) samples collected from the same well.

BGOURI

Four additional groundwater samples were collected at Site 15 during the BGOURI in 2000. TCE, the only VOC detected during the BGOURI, was not detected in groundwater at this site during previous sampling events. TCE was detected in three of four groundwater samples at concentrations ranging from 2.32 to 16 µg/L. The source of the TCE was unknown. Anthracene, fluoranthene, and pyrene were detected in one well at concentrations less than 100 µg/L. None of these SVOCs were detected in groundwater samples collected during the Phase II RI.

Fifteen inorganics were detected in groundwater samples collected from Site 15. Seven of the 15 metals were detected in all four samples. Cadmium, chromium, lead, nickel, and silver were detected at elevated concentrations. Lead was the only inorganic detected at significant levels during both the Phase II RI and BGOURI. Chromium and lead were detected in all four BGOURI samples.

Lead was detected at concentrations less than the risk-based COPC screening criterion in all samples except in 15MW1S01 (24.7 µg/L). Lead concentrations exceeded the background concentration in samples 15MW1S01 and 15MW2S01. The groundwater in 15MW2S was acidic (pH = 4.44), the groundwater in 15MW1S and 15MW3S was slightly acidic (pH = 5.75 and 5.91, respectively), and the groundwater in 15MW1D was near neutral (pH = 6.9). Lead was detected at 2.8 J µg/L in the deep overburden aquifer well 15MW1D. The pH data and the detected concentrations of lead indicate that residual contamination from the former SASDA is impacting the shallow overburden groundwater.

Silver was detected in 3 of 3 samples at concentrations ranging from 79.1 µg/L (15MW1D) to 615 µg/L (15MW2S). The maximum silver concentration was found in well 15MW2S, which also had the lowest pH (4.44). Concentrations of silver decrease in the downgradient direction, but the existing monitoring well network at Site 15 does not extend far enough downgradient to fully define the most downgradient extent of silver in groundwater. Even though the monitoring well network is limited at Site 15, silver was not detected in any downgradient groundwater samples at Site 23. Therefore, it does not appear that silver is migrating to downgradient locations at significant concentrations.

Of the 10 remaining detected metals, concentrations of aluminum, beryllium, and zinc were in excess of background concentrations.

BGOURI Update/FS

Additional groundwater samples were collected at Site 15 during a DGI in 2002 and analyzed to further define the nature and extent of contamination at the site. The sampling program focused on the groundwater contaminants, including TCE, chromium, and silver, identified during the BGOURI.

Groundwater samples were analyzed for TCL VOCs, TAL metals, and acidity. Table 2-3 summarizes the results for Site 15 groundwater samples collected for the BGOURI Update/FS.

Chloroform was the only VOC detected in the six groundwater samples. It was detected once in the sample from 15TW03 at a concentration of 3 µg/L. TCE, which was detected in groundwater samples from three monitoring wells (15MW1S, 15MW2S, and 15MW3S) during the BGOURI, was not detected in the groundwater samples collected from these wells or the three new temporary monitoring wells during the DGI. Considering both soil and groundwater data from Site 18 (and BGOURI groundwater data from other sites), it was determined that the detections of TCE in groundwater samples during the BGOURI were anomalies (apparently related to laboratory or field sampling issues) and are not indicative of a site or upgradient source issue.

Fifteen inorganics were detected in both total and filtered groundwater samples collected from Site 15 during the DGI. Zinc was detected at total and dissolved concentrations in excess of the background concentration. The dissolved concentrations of aluminum in two samples were also greater than the background level. The total and dissolved concentrations of inorganics were similar for the DGI samples, indicating that proper low-flow sampling techniques were used and that turbidity/total suspended solids (TSS) did not influence analytical results.

The inorganics cadmium, chromium, lead, nickel, silver, and zinc were identified as groundwater COPCs during the BGOURI. Cadmium was detected in only one sample (15TW02) during the DGI at a concentration (4.4 µg/L), similar to the maximum concentration (3.4 µg/L) detected during the BGOURI. Chromium, lead, and silver were detected at total concentrations that were one to three orders of magnitude lower during the DGI than the BGOURI. Nickel was not detected in any of the groundwater samples collected during the DGI. The maximum total zinc concentration during the DGI (365 µg/L) was detected in the same well (15MW2S) and at the same magnitude (349 µg/L) as during the BGOURI.

2.5.2.5 Site 18

An evaluation of the nature and extent of groundwater contamination at Site 18 is provided below. The discussion includes groundwater data collected during the BGOURI in 2000. Groundwater sample locations are shown on Figure 2-8, and Table 2-4 presents a summary of groundwater analytical results from the BGOURI.

No VOCs, SVOCs, pesticides, or PCBs were detected in the groundwater samples collected at Site 18.

Aluminum, beryllium, calcium, iron, magnesium, manganese, potassium, and sodium were detected in one or both of the groundwater samples collected at Site 18. The concentrations of these metals were all less than background levels except beryllium, which was not detected in background samples. The concentration of beryllium was les than the risk-based COPC screening level (Region 9 PRG) and CTDEP SWPC.

2.5.2.6 Site 20

Phase II RI

Overburden

No overburden groundwater samples were collected from Site 20 during the Phase I RI. Three overburden wells were installed and sampled during the Phase II RI; however, no VOCs were detected. Five SVOCs were detected at low concentrations. A common field and laboratory contaminant,

bis(2-ethylhexyl)phthalate, was detected in three of six samples at concentrations ranging from 2 µg/L to 3 µg/L. 1,3-DCB (0.6 µg/L), benzo(g,h,i)perylene (1 µg/L), dibenzo(a,h)anthracene (0.8 µg/L), and indeno(1,2,3-cd)pyrene (1 µg/L) were each detected in one of two groundwater samples collected from well 2WCMW1S.

Nineteen metals were detected in unfiltered groundwater samples collected from the overburden wells. Sixteen metals were detected in the corresponding filtered groundwater samples. A majority of the maximum concentrations of metals were associated with groundwater samples collected from well 2WCMW3S, located south of the site along the drainageway into Site 2B. Concentrations of metals in filtered and unfiltered samples were relatively similar (i.e., at the same order of magnitude). Notable concentrations reported for groundwater samples include the maximum concentrations of arsenic (19.9 µg/L), boron (3,810 µg/L), manganese (6,540 µg/L), and sodium (3,580,000 µg/L).

Bedrock

Three groundwater samples were collected (during the Phase I RI and Rounds 1 and 2 of the Phase II RI) from a single Site 20 bedrock well (2WMW4D). Six VOCs, including three ketones and three halogenated aliphatics, were detected at concentrations ranging from 1 µg/L to 12 µg/L. Three SVOCs were detected at concentrations ranging from 2 µg/L to 7 µg/L. Benzoic acid and di-n-octyl phthalate were each detected in one of three samples, and bis(2-ethylhexyl)phthalate was detected in two of three samples.

Thirteen inorganics were detected in unfiltered groundwater samples collected from the bedrock. Seven inorganics were detected in the corresponding filtered groundwater samples. The maximum concentrations of a majority of inorganics in overburden well samples were more than an order of magnitude greater than respective maximum concentrations of inorganics detected in bedrock well samples.

BGOURI

Overburden

TCE and 4-methyl-2-pentanone were the only VOCs detected in the groundwater samples collected from the overburden wells at Site 20. TCE and 4-methyl-2-pentanone were detected in one sample from well 2WCMW2S at concentrations of 5.02 µg/L and 1.29 J µg/L, respectively. VOCs were not detected in groundwater samples collected from the overburden aquifer during previous investigations.

PAHs and 4-methylphenol were the only SVOCs detected in groundwater samples collected from the overburden aquifer. PAHs were detected in one groundwater sample from well 2WCMW2S at

concentrations ranging from 0.03 µg/L [benzo(k)fluoranthene] to 0.13 µg/L (fluoranthene). 4-Methylphenol was detected in one sample from well 2WCMW3S at a concentration of 9 µg/L. PAHs were also detected at low concentrations in groundwater samples collected during previous investigations.

Sixteen metals were detected in unfiltered overburden groundwater samples, and two metals (calcium and zinc) were detected in filtered overburden groundwater samples. The concentrations of the metals were higher in unfiltered samples than in filtered samples. In general, metals were also detected at similar concentrations (i.e., at the same order of magnitude) in groundwater samples collected during the previous investigations.

Bedrock

TCE, at a concentration of 3.8 µg/L, was the only VOC detected in the groundwater sample collected from the bedrock aquifer. TCE was also detected at similar concentrations in groundwater samples from the bedrock aquifer during previous investigations.

No SVOCs were detected in the groundwater sample collected from the bedrock aquifer. Benzoic acid, bis(2-ethylhexyl) phthalate, and di-n-octyl phthalate were detected at low concentrations in groundwater from the bedrock aquifer during previous investigations.

Calcium, magnesium, potassium, and sodium were the only inorganics detected in the groundwater sample from the bedrock aquifer. These inorganics were also detected at similar concentrations (i.e., at the same order of magnitude) in groundwater samples collected from the bedrock aquifer during previous investigations.

BGOURI Update/FS

Monitoring wells 2WCMW1S and 2WCMW2S were resampled during the DGI and analyzed for total and dissolved TAL inorganics. Wells 2WCMW1S and 2WCMW2S were resampled because elevated concentrations of silver were detected during the BGOURI. Other groundwater COCs identified during the BGOURI risk assessment included TCE, benzo(a)pyrene, arsenic, and thallium. These COCs were further evaluated during the preparation of the DGI Work Plan. Factors such as the frequency and magnitude of the detections and the source of the contamination were evaluated, and it was determined that additional investigation of these four COCs was not warranted during the DGI.

Table 2-5 summarizes the analytical results for chemicals detected in groundwater at Site 20 during the DGI. The concentrations of inorganics detected during the DGI were typically lower than concentrations

detected during the BGOURI. Concentrations of arsenic, chromium, copper, lead, silver, and zinc were significantly lower in well 2WCMW1S. The silver concentration in 2WCMW2S also decreased significantly. Some exceptions were aluminum and zinc, which were detected at higher concentrations in well 2WCMW2S during the DGI.

2.5.2.7 Sites 9 and 23

BGOURI

During BGOURI field activities in 2000, groundwater samples were collected from monitoring wells at Site 23 completed in the overburden and bedrock aquifers (TtNUS, 2002a). VOCs and SVOCs were detected infrequently in groundwater samples collected during the BGOURI. Metals were detected frequently in groundwater samples, but the detections are likely related to the fill material used to construct the fuel farm. The RI recommended postponing any decisions on the groundwater at Site 23 until a sufficient amount of data was available from the groundwater collection system monitoring program to properly characterize the groundwater.

Storm Sewer Rehabilitation

The storm sewer system at Site 23 was rehabilitated in 2000 (FWEC, 2001). After completion of the storm sewer system, groundwater collected from the deep dewatering system around the closed USTs is conveyed to a metering pit within the tank farm. The metering pit is connected to the shallow stormwater system, and the water collected by the system is conveyed to the Thames River. The Navy initiated a sampling program for the deep groundwater collection system after construction activities were completed.

Seven groundwater samples were collected from the metering pit between July 25, 2000 and May 23, 2001. The analytical results varied per round and no comparisons of data to Connecticut criteria were completed, but in general, the groundwater samples did not contain significant concentrations of contaminants typically found in fuel oil.

Quarterly Underdrain Metering Pit Sampling

Metering pit sampling was conducted quarterly beginning in June 2007 to evaluate the quality of groundwater being collected and conveyed by the underdrain piping (TtNUS, 2008c). Table 2-6 summarizes data from quarterly metering pit sampling. Exceedances of applicable Connecticut groundwater criteria (for surface water protection) included arsenic in the unfiltered sample during the second quarterly event (September 2007) and seven SVOCs in one sample during the third sampling event (December 2007). However, both of these exceedances were attributed to suspended solids particles and not site-related contamination. The results of the four quarterly sampling events indicate

that groundwater from Site 23 (which includes Site 9) being collected and conveyed in the storm sewer system does not pose a significant risk to human health or the environment under current and expected future land use (non-residential).

2.5.2.8 Summary of Nature and Extent of Contamination

Site 2

Eight years of groundwater monitoring under the OU1 ROD have been completed. Year 7 (2006) results, the most recent available, indicate that copper was the only contaminant detected in groundwater at concentrations in excess of criteria. Based on the results of the monitoring program to date, the landfill cap is working properly and significant contaminant migration from the landfill to groundwater is not occurring.

Site 3

Chlorinated VOCs (e.g., cis-1,2-dichloroethene, TCE, and VC) and PAHs were the primary contaminants detected in the groundwater at Site 3. Chlorinated VOCs were detected during all of the investigations, and it is likely that their detections are the result of solvents being released to groundwater via the two former septic systems and associated leach fields at Site 7 and migrating downgradient to Site 3. The concentrations of the VOCs detected during the most recent investigation (2002) were less than concentrations detected during previous investigations (1994), indicating that a continuing source of contamination is not present and that natural degradation processes are working. The VOCs were found primarily along the length of Stream 5. The PAHs, which were detected infrequently, were found to be related to suspended solids in samples collected from recently installed and sampled temporary wells and not a site-specific groundwater concern.

Site 7

Investigations at Site 7 found contaminants such as benzene, chlorobenzenes (1,4-DCB, CB, and HCB), phenanthrene, and TCE in the groundwater. The contaminants were probably released to the groundwater via the two historical septic systems and associated leach fields.

Site 14

A single well was installed at Site 14 and sampled in 1994 and 2000. Naturally occurring metals were the only chemicals consistently detected in the groundwater at this site.

Site 15

Historical investigations at Site 15 identified TCE and inorganics (cadmium, chromium, lead, nickel, silver, and zinc) as the primary groundwater contaminants. SVOCs were also detected infrequently at low concentrations. A DGI was conducted to confirm the historic results. TCE was not detected in the DGI groundwater samples. Chromium, lead, nickel, and silver were either not detected or detected at much lower concentrations during the DGI. The DGI results showed that the previous results were anomalies that may have been caused by the groundwater sampling technique used to collect the samples.

Site 18

No VOCs, SVOCs, pesticides, or PCBs were detected in the groundwater samples collected at Site 18. Aluminum, beryllium, calcium, iron, magnesium, manganese, potassium, and sodium were detected at concentrations less than background levels except beryllium, which was less than the risk-based COPC screening level (Region 9 PRG) and CTDEP SWPC.

Site 20

The overburden and bedrock groundwater at Site 20 was characterized during three separate investigations. VOCs and SVOCs were detected sporadically at low concentrations in the overburden and bedrock groundwater during the investigations. Naturally occurring metals were detected consistently in the groundwater.

Sites 9 and 23

The results of the four quarterly sampling events indicate that groundwater from Site 23 (which includes Site 9) being collected and conveyed in the storm sewer system does not pose a significant risk to human health or the environment under current and expected future land use (non-residential).

2.6 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

NSB-NLON is currently an active Navy base and is expected to remain so into the foreseeable future. Reasonably anticipated future land uses of Sites 2A, 2B, 3, 7, 14, 15, 18, 20, and 23 include continued use for their current Naval functions.

Sites 2A, 2B, 3, 7, and 14 are located within designated ESQD arcs of Site 20; therefore, further development is not planned for this area. Navy regulations prohibit construction of inhabited buildings or structures within these arcs and, although existing buildings operate under a waiver of these regulations, no further construction or residential development is planned for of these sites.

Groundwater in the overburden and bedrock at Sites 2A, 2B, 3, 7, 14, 15, 18, 20, and 23 is classified as GB by the State of Connecticut. Based on the GB classification, the groundwater is presumed not suitable for human consumption without treatment. Neither aquifer is currently used as a source of drinking water or for industrial water supply purposes, and there are no current plans to use either aquifer in the future for drinking water or industrial water supply purposes. The overburden groundwater discharges locally to streams that eventually discharge to the Thames River or directly to the Thames River. The overburden aquifer is hydraulically connected to the bedrock aquifer.

2.7 SUMMARY OF SITE RISKS

The purpose of a risk assessment is to estimate the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminated media at a site. The results of the risk assessment provide the basis for taking action and identify the contaminants and exposure pathways that need to be addressed by the RA.

The human health risks associated with exposure to OU9 groundwater were evaluated as part of the following investigations:

- Phase II RI (B&RE, 1997) – Sites 2, 3, 7, 14, 15, and 20
- BGOURI (TtNUS, 2002a) – Sites 2A, 3, 7, 14, 15, 18, 20, and 23
- BGOURI Update/FS (TtNUS, 2004) – Sites 3, 7, 14, 15, and 20

In addition, human health risk assessment (HHRA) results for Sites 2 and 23 were re-evaluated in 2008 to evaluate the effects of more recent data and updated guidance. The HHRA memoranda describing these updates are included in Appendix E of this ROD. Also in Appendix E is a 2008 memorandum evaluating risks from vapor intrusion of VOCs from groundwater into the indoor air of current industrial and potential future residential buildings on OU9 sites. The HHRA for Site 20 was also updated in 2008 to evaluate the effects of more recent data and updated guidance. The results of the Site 20 re-evaluation are provided in Appendix F.

Ecological risk assessments were conducted for Sites 2A and 2B as part of the Phase II RI and the ongoing Phase III investigation. Potential ecological risks associated with Site 3 - NSA groundwater after discharging to a surface water body were evaluated in the BGOURI Update/FS.

The results of these risk assessments, as relevant to Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20 and 23 groundwater, are provided below and tabulated as follows.

Summary of Cancer Risks and Hazard Indices

Risk	Site 2A	Site 2B	Site 3	Site 7
Construction Workers – Direct Exposure				
Cancer Risk	1.2 per 100,000,000	3.3 per 100,000,000	1.3 per 1,000,000	4.2 per 10,000,000
Hazard Index	0.006	0.2	0.001	0.09
Adult Residents – Direct Exposure				
Cancer Risk	3.3 per 10,000	NA	1.4 per 1000	6.4 per 10,000
Hazard Index	6.4	NA	2.4	5.6
Industrial Workers – Vapor Intrusion				
Cancer Risk	1.1 per 1,000,000,000	1.4 per 100,000,000	2.3 per 1,000,000	6.2 per 1,000,000,000
Hazard Index	0.000003	0.00003	0.01	0.00001
Adult Residents – Vapor Intrusion				
Cancer Risk	7.8 per 1,000,000,000	9.8 per 100,000,000	1.6 per 100,000	4.2 per 100,000,000
Hazard Index	0.00002	0.0001	0.06	0.00008

Risk	Site 15	Sites 14 and 18	Site 20	Sites 9 and 23
Construction Workers – Direct Exposure				
Cancer Risk	No COPCs	No COPCs	1.2 per 100,000,000	8.8 per 100,000,000
Hazard Index	0.002	No COPCs	0.0002	0.2
Adult Residents – Direct Exposure				
Cancer Risk	No COPCs	No COPCs	6.5 per 100,000	2.6 per 10,000
Hazard Index	0.3	No COPCs	0.3	13
Industrial Workers – Vapor Intrusion				
Cancer Risk	5.1 per 10,000,000	No COPCs	1.1 per 100,000,000	3.4 per 10,000,000
Hazard Index	0.001	No COPCs	0.00003	0.0008
Adult Residents – Vapor Intrusion				
Cancer Risk	3.5 per 1,000,000	No COPCs	7.4 per 100,000,000	2.3 per 1,000,000
Hazard Index	0.007	No COPCs	0.0001	0.005

NA - Not applicable. A residential scenario was not evaluated because Site 2B is a wetland.

No COPCs - Maximum concentrations of all chemicals were less than the screening criteria; therefore, no evaluation was required.

2.7.1 Human Health Risk Assessment

The major components of a HHRA include data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis. Data evaluation is a task that uses a variety of information to determine which of the chemicals detected in site media are most likely to present a risk to potential receptors. The end result of the evaluation is a list of COPCs and representative exposure point

concentrations for each medium. During the exposure assessment, potential human exposure pathways are identified at the source areas under consideration. Chemical-specific toxicity criteria for the identified COPCs are identified during the toxicity assessment and are used in the quantification of potential human health risks. Risk characterization involves quantifying the risks associated with exposure to the COPCs using algorithms established by EPA and CTDEP. Risks from chemicals are calculated for either carcinogenic or noncarcinogenic effects. The uncertainty analysis identifies limitations in the risk assessment that might affect the final risk results. The final result of the risk assessment is the identification of medium-specific COCs and exposure pathways that need to be addressed by an RA.

For the Phase II RI HHRA, COPCs for groundwater were identified by comparing maximum concentrations to EPA Region 3 Risk-Based Concentrations (RBCs) for tap water ingestion. For the BGOURI and BGOURI Update/FS, COPCs for groundwater were identified by comparing maximum detected concentrations of contaminants to EPA Region 9 Preliminary Remediation Goals (PRGs) for tap water, Region 3 RBCs for tap water, CTDEP Groundwater Protection Criteria (GA/GAA), EPA Maximum Contaminant Levels (MCLs), Connecticut MCLs, CTDEP RSRs for migration of groundwater to surface water, CTDEP RSRs for volatilization from groundwater to indoor air, and background concentrations. If the maximum concentration exceeded any criterion, the chemical was retained as a COPC for all associated exposure routes.

Potential receptors for the HHRAs for exposures to groundwater included construction workers and future adult residents, with the exception of the Phase II HHRA, which only evaluated potential exposures to groundwater for construction workers. Future residential receptors were evaluated only to provide an indication of potential risks if the facility was closed and subsequently developed for residential use. Potential exposure pathways are summarized in Table 2-7. These pathways consider the potential for exposure based on present use, potential future use, and location of the sites. Exposure assumptions for the receptors and toxicity information for the COPCs were presented in the Phase II RI (B&RE, 1997), BGOURI (TtNUS, 2002a), and BGOURI Update/FS (TtNUS, 2004) and are not reiterated in this ROD.

Exposure point concentrations for each of the COPCs were developed for reasonable maximum exposure (RME) and central tendency exposure (CTE) scenarios. For the Phase II and BGOURI HHRAs, the maximum and average concentrations were used for the groundwater exposure point concentrations under the RME and CTE scenarios, respectively. Based on the limited data set in the BGOURI Update/FS, the maximum detected concentration was used as the groundwater exposure point concentration under the RME and CTE scenarios.

Potential human health risks resulting from exposure to COPCs were estimated using algorithms established by EPA and CTDEP. The algorithms are used to calculate risk as a function of chemical

concentration, human exposure parameters, and toxicity. Risks attributable to exposure to chemical carcinogens were estimated as the probability of an individual developing cancer over a lifetime [incremental cancer risk (ICR)]. According to EPA, risks less than 1×10^{-6} (or a risk of less than one in one million) are generally considered to be "acceptable," and risks greater than 1×10^{-4} (1 in 10,000) are generally considered to be "unacceptable." According to CTDEP, risks less than 1×10^{-5} (1 in 100,000) for cumulate risk or 1×10^{-6} (1 in 1,000,000) for individual chemicals are generally considered to be "acceptable," while risks greater than 1×10^{-5} for cumulative risk or 1×10^{-6} for individual chemicals are generally considered to be "unacceptable." The hazards associated with the effects of noncarcinogenic chemicals were evaluated by comparing an exposure level or intake to a reference dose. If the ratio of the intake of a chemical to the reference dose [hazard quotient (HQ)] exceeds unity, noncarcinogenic (toxic) effects may occur. A hazard index (HI) was generated by summing the individual HQs for all the COPCs associated with a specific pathway. If the value of the HI exceeds unity, noncarcinogenic health effects associated with that particular chemical mixture may occur, and therefore it is necessary to segregate the HQs by target organ effects or mechanism of action. The HQ should not be construed as a probability in the manner of the ICR, but rather as a numerical indicator of the extent to which a predicted intake exceeds or is less than a reference dose (RfD). The results of the HHRAs for Sites 2, 3, 7, 14, 15, 18, 20, and 23 (which includes Site 9) are discussed below.

2.7.1.1 Site 2

Human health risks associated with Site 2 groundwater were evaluated during the Phase II RI and BGOURI (Site 2A only) and were re-evaluated in a 2008 technical memorandum based on changes to risk assessment guidance and collection of additional data.

The HHRA for Site 2B groundwater performed as part of the Phase II RI evaluated cancer and non-cancer risks for current and future construction workers (the only receptor expected to be exposed to site groundwater under current and reasonably anticipated future land uses). The estimated cancer risk of 4×10^{-7} for construction workers was less than EPA's target risk range and CTDEP's target risk. The cumulative non-cancer risk associated with exposure to groundwater for the construction worker was less than the EPA and CTDEP acceptable level of 1.0 for the CTE scenario but exceeded 1.0 for the RME scenario. The elevated non-cancer hazard was primarily attributed to dermal exposure to manganese, which is relatively abundant in the environment. The chemical-specific risk for manganese via dermal contact (1.7) slightly exceeded 1.0 and was based on very conservative exposure assumptions (exposure of construction workers to groundwater for 8 hours per day for 120 days per year). A re-evaluation of manganese data based on more realistic exposure assumptions (4 hours per day for 30 days) results in an HI of 0.2, less than the EPA and CTDEP acceptable level.

The results of the Phase II RI risk assessment for Site 2A indicated potentially unacceptable cancer and non-cancer risks based on exposure of construction workers to groundwater at the site. However, this risk assessment was conducted using data collected prior to capping of the landfill. The risk assessment was updated as part of the BGOURI, as discussed below.

Potential groundwater receptors evaluated included only construction workers potentially exposed to groundwater via dermal contact while excavating building foundations. Because of the nature of the site (i.e., a covered former landfill), a future residential exposure scenario was not considered. Maximum and average concentrations were used to represent exposure point concentrations for the RME and CTE scenarios, respectively. No carcinogenic toxicity factors were available for the identified COPCs; consequently, cancer risks were not estimated for construction workers exposed to groundwater. HIs for construction workers exposed to groundwater were 0.00008 and 0.00004 for the RME and CTE scenarios, respectively, less than EPA's and CTDEP's acceptable level of 1.0.

The HHRA conducted for Site 2 groundwater during the BGOURI was re-evaluated in 2008 to determine if changes in EPA and CTDEP risk assessment guidance and recently collected groundwater data (August and December 2006 groundwater monitoring results) affected the risk assessment conclusions. The most recent VOC data were also re-evaluated to estimate risks associated with vapor intrusion. The following is a summary of the results of these re-evaluations:

- The HHRA for Site 2A prepared during the BGOURI evaluated potential risks from exposures to groundwater by construction workers. The HHRA determined that risks for construction workers were within USEPA and CTDEP acceptable levels. Potential risks for construction workers exposed to Site 2A groundwater would still be acceptable using the analytical results from the most recent rounds of groundwater sampling.

- Risks to hypothetical future residents using Site 2 groundwater as a drinking water supply would exceed USEPA and CTDEP acceptable levels, although residential development of Site 2A is prohibited.

- The vapor intrusion evaluation for groundwater determined that risks from vapor intrusion were within USEPA and CTDEP acceptable levels for residential and industrial scenarios. The evaluation concluded that no further action was required for vapor intrusion issues at Site 2.

The memoranda for these re-evaluations are included in Appendix E.

2.7.1.2 Site 3

The BGOURI Update/FS HHRA evaluated risks from exposure to Site 3 groundwater for construction workers and hypothetical future adult residents. Dermal contact with groundwater was the exposure route evaluated for construction workers, and exposures to groundwater through direct ingestion, dermal contact while showering/bathing, and inhalation of volatiles while showering/bathing were evaluated for hypothetical adult residents.

Tables 2-8 and 2-9 present the risk estimates from the BGOURI Update/FS HHRA for Site 3 under the RME and CTE scenarios, respectively. Although not presented in Tables 2-8 and 2-9, the risk estimates from the Phase II HHRA and BGOURI HHRA are comparable to those presented in the BGOURI Update/FS HHRA. Risk Assessment Guidance for Superfund (RAGS) Part D tables for Site 3 (Summary of Receptor Risks and Hazards for COPCs) are included in Appendix F.

Cumulative ICRs and HIs for exposures to groundwater by construction workers were within the EPA and CTDEP acceptable ranges for both the RME and CTE scenarios. ICRs and HIs exceeded the EPA and CTDEP acceptable ranges for hypothetical adult residents under the RME and CTE scenarios. Carcinogenic PAHs, VC, and arsenic were the major contributors to the unacceptable risks. These risks are subject to several sources of uncertainty as discussed below.

Carcinogenic PAHs were only detected in one groundwater sample, which was collected from a temporary monitoring well. The turbidity associated with this groundwater sample was elevated: consequently, the carcinogenic PAHs detected in the groundwater sample from this well are believed to be associated with suspended solids in the groundwater sample and are not believed to be dissolved constituents in groundwater. Therefore, the cancer risks presented in the HHRA for exposures to carcinogenic PAHs in groundwater were determined to be overestimated and not representative of actual site risks. PAHs were not retained as final COCs for Site 3 groundwater.

Arsenic was only detected in two of eight groundwater samples collected during the DGI. The concentrations of dissolved arsenic in the groundwater samples are comparable to the background dissolved arsenic concentration. It is likely that the elevated arsenic concentration detected in one unfiltered groundwater sample (2DMW29S) is related to the suspended solids in the groundwater sample. Therefore, the carcinogenic and noncarcinogenic risks presented in the HHRA for exposures to arsenic in groundwater were determined to be overestimated and not representative of actual site risks. Arsenic was not retained as a final COC for Site 3 groundwater.

1,1,2-Trichloroethene and alpha-BHC were only detected once in groundwater samples collected from temporary wells. The 1,1,2-trichlroethane concentration was less than federal and State MCLs and the

CTDEP RSR. No other criteria were available to evaluate the detection of alpha-BHC. The risk associated with alpha-BHC (dermal = 2.1 x 10^{-6} and ingestion = 1.2 x 10^{-6}) marginally exceeded CTDEP's 1 x 10^{-6} risk level for individual chemicals. Based on the low frequencies of detections, the uncertainty associated with data from temporary wells, and the marginal risks associated with the two chemicals, 1,1,2-trichloroethene and alpha-BHC were determined not be COCs for Site 3 groundwater.

Although estimated risks from exposure to concentrations of TCE in groundwater from Site 3 did not exceed acceptable levels, TCE was included as a final COC for Site 3 groundwater because it was detected at concentrations that exceeded federal and state MCLs and the CTDEP RSR. Therefore, based on the results of the risk assessment and comparisons to risk-based criteria, COCs for Site 3 groundwater include TCE and VC.

Groundwater data from the Year 1 Annual Groundwater Monitoring Report for Sites 3 and 7 (TtNUS, 2007) were used to evaluate the potential for vapor intrusion at Site 3 (see Appendix E.3). Based on comparisons of detected VOC concentrations to EPA and CTDEP screening criteria for vapor intrusion, chloroform, TCE, and VC were retained for further evaluation using the Johnson and Ettinger Vapor Intrusion Model (EPA, 2004). Modeling results showed that cancer risks and hazard indices for residential and industrial scenarios did not exceed EPA acceptable levels. Cancer risks for chloroform and VC for residential exposures exceeded CTDEP acceptable risk levels. Cancer risks for TCE based on California Environmental Protection Agency toxicity criteria (as recommended by EPA Region 1) were within CTDEP acceptable levels for residential and industrial scenarios, but cancer risks based on draft EPA toxicity criteria exceeded CTDEP acceptable levels.

The Johnson and Ettinger Vapor Model was also used to calculate site-specific, risk-based, residential and industrial PRGs and CTDEP RSRs for vapor intrusion. The maximum detected concentration of chloroform exceeds the site-specific PRG for residential exposures but is less than the site-specific PRG for industrial exposures, EPA MCL, and CTDEP RSRs for vapor intrusion. Because the modeling only showed potential cancer risks exceeding CTDEP acceptable levels and because the maximum chloroform concentration did not exceed CTDEP RSRs for vapor intrusion, it is determined that there are no vapor intrusion issues associated with chloroform and no further action is required. The maximum detected concentration of TCE exceeds the EPA MCL but is less than the site-specific PRGs and CTDEP RSRs for vapor intrusion. A groundwater monitoring program and LUCs are in place to address the exceedance of the EPA MCL for trichloroethene. Therefore, no further action is required for vapor intrusion issues associated with TCE.

The maximum detected concentration of VC (at well 2DMW29S) exceeds the EPA MCL, site-specific PRGs, and residential CTDEP RSR for vapor intrusion. A groundwater monitoring program and LUCs are in place to address the exceedance of the EPA MCL for VC. Based on comparisons to CTDEP RSRs for vapor

intrusion, the VC concentration detected in groundwater at monitoring well 2DMW29S does not represent a vapor intrusion issue under the current industrial scenario but may be an issue under a future residential scenario. Risks associated with a building constructed in the vicinity of monitoring well 2DMW29S for industrial purposes would be acceptable; however, associated risks for a building within 100 feet of 2DMW29S for residential use would be unacceptable unless steps were taken to mitigate vapor intrusion.

2.7.1.3 Site 7

The BGOURI Update/FS HHRA evaluated risks from exposure to Site 7 groundwater for construction workers and hypothetical future adult residents. Dermal contact with groundwater was the exposure route evaluated for construction workers, and exposures to groundwater through direct ingestion, dermal contact while showering/bathing, and inhalation of volatiles while showering/bathing were evaluated for hypothetical adult residents.

Tables 2-10 and 2-11 present the risk estimates from the BGOURI HHRA for Site 7 under the RME and CTE scenarios, respectively. Only the results from the BGOURI HHRA are presented in these tables because no new data were collected during the DGI for the BGOURI Update and no changes to the HHRA were made during the BGOURI Update. Although not presented in Tables 2-10 and 2-11, the risk estimates from the Phase II HHRA are comparable to those presented in the BGOURI HHRA. RAGS Part D tables for Site 7 (Summary of Receptor Risks and Hazards for COPCs) are included in Appendix F.

Cumulative ICRs and HIs resulting from exposure to groundwater by construction workers were within EPA and CTDEP acceptable ranges for both the RME and CTE scenarios. ICRs and HIs exceeded EPA and CTDEP acceptable ranges for hypothetical adult residents under the RME and CTE scenarios. Benzene, bis(2-ethylhexyl) phthalate, HCB, 1,4-DCB, TCE, arsenic, and chromium were the major contributors to the unacceptable risks. These risks are subject to several sources of uncertainty as discussed below.

Bis(2-ethylhexyl) phthalate was detected infrequently in groundwater and is a common laboratory contaminant is typically associated with plastics (well casings, plastic bottleware, etc). It is unlikely that the detections of bis(2-ethylhexyl) phthalate are associated with a Site 7 source. Based on this information, it was determined that the elevated risks from exposures to bis(2-ethylhexyl) phthalate were overestimated and limited to a small section of Site 7. Bis(2-ethylhexyl) phthalate was not retained as a final COC for site 7 groundwater.

Arsenic and chromium were detected infrequently in groundwater samples collected during the BGOURI. Detected concentrations of arsenic were less than the Connecticut MCL in all samples and only exceeded

the EPA MCL in the sample from temporary monitoring well 7TW09. Detected concentrations of chromium only exceeded the EPA MCL and Connecticut MCL in the groundwater sample from temporary monitoring well 7TW09. The detected concentrations of most other metals were significantly higher in the sample from temporary monitoring well 7TW09 compared to concentrations in samples from other monitoring wells. The total suspended solids content in the groundwater sample from 7TW09 was two orders of magnitude greater than in any of the groundwater samples from the other wells. It is likely that the elevated arsenic and chromium concentrations detected in the groundwater sample from 7TW09 are related to the suspended solids in the groundwater sample and are not believed to be dissolved constituents in groundwater. Therefore, the cancer risks and HIs presented for arsenic and chromium were determined to be overestimated and not representative of actual site risks. Arsenic and chromium were not retained as final COCs for Site 7 groundwater.

Although estimated risks from exposure to concentrations of CB in groundwater from Site 7 did not exceed acceptable levels, CB was included as a final COC for Site 7 groundwater because it was detected at concentrations that exceeded federal and state MCLs and the CTDEP RSR. Therefore, based on the results of the risk assessment and comparisons to risk-based criteria, COCs for Site 7 groundwater include benzene, CB, 1,4-DCB, HCB, and TCE.

The results of the 2008 vapor intrusion evaluation indicated that NFA is required for vapor intrusion issues at Site 7 (see Appendix E.3).

2.7.1.4 Site 14

The BGOURI Update/FS HHRA evaluated risks from exposure to Site 14 groundwater for construction workers and hypothetical future adult residents. Dermal contact with groundwater was the exposure route evaluated for construction workers, and exposures to groundwater through direct ingestion, dermal contact while showering/bathing, and inhalation of volatiles while showering/bathing were evaluated for hypothetical adult residents.

A summary of Site 14 groundwater data from the BGOURI Update/FS is presented in Table 2-12. Concentrations of all chemicals in Site 14 groundwater were less than all available screening criteria and basewide background levels. Iron and manganese concentrations exceeded secondary MCLs; however, secondary MCLs are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water and are not associated with unacceptable health risks. Consequently, no COCs were retained for Site 14 groundwater, and no adverse health effects are anticipated from exposure to Site 14 groundwater.

The results of the 2008 vapor intrusion evaluation indicated that NFA is required for vapor intrusion issues at Site 14 (see Appendix E.3).

2.7.1.5 Site 15

The BGOURI Update/FS HHRA evaluated risks from exposure to Site 15 groundwater for construction workers and hypothetical future adult residents. Dermal contact with groundwater was the exposure route evaluated for construction workers, and exposures to groundwater through direct ingestion, dermal contact while showering/bathing, and inhalation of volatiles while showering/bathing were evaluated for hypothetical adult residents.

Tables 2-13 and 2-14 present the risk estimates from the BGOURI Update/FS HHRA for Site 15 under the RME and CTE scenarios, respectively. RAGS Part D tables for Site 15 (Summary of Receptor Risks and Hazards for COPCs) are included in Appendix F.

No carcinogenic COPCs were identified in groundwater; therefore, no ICRs were calculated for exposures to groundwater. HIs for exposures to groundwater by construction workers and future adult residents were within the EPA and CTDEP acceptable ranges for both the RME and CTE scenarios. Consequently, no COCs were retained for Site 15 groundwater, and no adverse health effects are anticipated from exposure to Site 15 groundwater.

The results of the 2008 vapor intrusion evaluation indicated that NFA is required for vapor intrusion issues at Site 15 (see Appendix E.3).

2.7.1.6 Site 18

The Site 18 groundwater COPCs and the screening criteria used to identify them are summarized in Tables 2-15 and 2-16. No human health COPCs were identified for groundwater; therefore, no ICRs and HIs were calculated for exposures to groundwater.

Manganese in groundwater was the only chemical with a maximum detected concentration that exceeded its direct contact screening criteria but was not retained as a COPC based on a comparison to background levels. Exposures to groundwater were not evaluated in the HHRA because no COPCs were identified for groundwater at Site 18, although potential receptors for exposures to groundwater would be construction workers and adult residents. Potential risks from dermal exposures to manganese in water are insignificant (EPA, 2001); consequently, the elimination of manganese as a COC on the basis of background would not affect risk estimates for the construction worker because this receptor would only be evaluated for dermal exposures to groundwater. Potential exposure pathways for future adult

residents include ingestion and dermal contact with groundwater. If exposure to manganese in groundwater by a future adult resident were evaluated in the HHRA, the resulting HQ for manganese would be 0.4, which is less than the EPA and CTDEP acceptable level of 1.0, indicating that no adverse health effects are anticipated for adult residents exposed to manganese in groundwater at Site 18.

The HHRA, data screening results, and uncertainty analysis showed that there are no groundwater COCs for Site 18, and no adverse health effects are anticipated form exposure to Site 18 groundwater.

Because no VOCs were detected in groundwater samples collected at Site 18 during the BGOURI, vapor intrusion is not an issue at the site.

2.7.1.7 Site 20

Risks from exposures to Site 20 groundwater for construction workers and hypothetical adult residents were evaluated in the Phase II HHRA and BGOURI HHRA. A screening risk evaluation was presented in the BGOURI Update/FS, although the data set from the BGOURI Update/FS only included metals. In 2008, the risks for exposures to groundwater at Site 20 were re-evaluated using the most recent data set, which consisted of organic sample results from the BGOURI and inorganic sample results from the DGI. The re-evaluation estimated risks from exposure to Site 20 groundwater for construction workers and hypothetical future adult residents. Dermal contact with groundwater and inhalation of volatiles were the exposure routes evaluated for construction workers, and exposures to groundwater through direct ingestion, dermal contact while showering/bathing, and inhalation of volatiles while showering/bathing were evaluated for hypothetical adult residents.

Tables 2-15 and 2-16 present the latest risk estimates for the combined DGI and BGOURI groundwater data set under the RME and CTE scenarios, respectively. RAGS Part D tables for Site 20 (Summary of Receptor Risks and Hazards for COPCs) are included in Appendix F. Cumulative ICRs and HIs for exposures to groundwater by construction workers were within EPA and CTDEP acceptable risk ranges for both the RME and CTE scenarios. For hypothetical adult residents, cumulative ICRs and HIs were within EPA acceptable risk ranges for both the RME and CTE scenarios. ICRs for hypothetical adult residents exceeded the CTDEP acceptable risk level of 10^{-5} for cumulative exposures under the RME scenario and the CTDEP acceptable level of 10^{-6} for individual chemicals under the CTE scenario. Benzo(a)pyrene and arsenic were the major contributors to the unacceptable CTDEP risks. The risks estimated in the re-evaluation are subject to several sources of uncertainty as discussed below.

ICRs for benzo(a)pyrene and arsenic exceeded CTDEP acceptable levels in the risk re-evaluation. Benzo(a)pyrene was not detected in groundwater samples collected during the Phase II RI and was only detected in one groundwater sample collected during the BGOURI. The detected concentration of

benzo(a)pyrene (0.05 µg/L) was less than the federal MCL (0.2 µg/L) and the Connecticut GA/GAA groundwater criterion (0.2 µg/L). Therefore, benzo(a)pyrene was not considered as a COC in Site 20 groundwater.

The concentration of arsenic in one well (2WCMW1S) during the DGI was near the background concentration and less than the federal MCL, Connecticut GA/GAA groundwater criterion, and Connecticut MCL. Arsenic is known to be related to dredge spoils in the area, and it is not likely to be related to a Site 20 source. Consequently, arsenic was not retained as a COC for groundwater at Site 20. Therefore, no COCs for direct contact exposures to groundwater at Site 20 were identified, and no adverse health effects are anticipated from exposure to Site 20 groundwater.

The results of the 2008 vapor intrusion evaluation indicated that NFA is required for vapor intrusion issues at Site 20 (see Appendix E.3).

2.7.1.8 Site 23

Human health risks associated with groundwater at Site 23 were evaluated during the BGOURI (TtNUS, 2002) and were re-evaluated in a 2008 technical memorandum based on changes to risk assessment guidance and collection of additional data.

Maximum detected concentrations of PCE, naphthalene, and lead in groundwater during the BGOURI exceeded risk-based screening levels (Region 9 PRGs) and were retained as COPCs.

ICRs for construction workers exposed to groundwater were 1.3×10^{-9} and 1.1×10^{-10} for the RME and CTE scenarios, respectively, which are less than USEPA's target risk range of 10^{-4} to 10^{-6} and CTDEP's acceptable risk level of 10^{-5} for cumulative exposures. The ICRs for future adult residents exposed to groundwater were 4.5×10^{-6} and 1.6×10^{-7} for the RME and CTE scenarios, respectively, which are less than or within USEPA's target risk range and less than CTDEP's acceptable risk level for cumulative exposures. The chemical-specific ICR for tetrachloroethene under the RME scenario exceeded CTDEP's target level of 1×10^{-6} for individual chemicals; however, the maximum detected concentration for tetrachloroethene was less than its CTDEP RSR.

HIs for construction workers exposed to groundwater were 0.0002 and 0.0001 for the RME and CTE scenarios, respectively, which are less than USEPA's and CTDEP's acceptable level of 1.0. HIs for adult residents exposed to groundwater were 0.02 and 0.005 for the RME and CTE scenarios, respectively.

Risks estimated during the BGOURI for the RME scenario at Site 23 are presented in Table 2-17. The conclusions of the HHRA conducted for Site 23 groundwater as part of the BGOURI were as follows:

- Cancer risks for construction workers and non-cancer risks for construction workers and hypothetical future adult residents exposed to groundwater at Site 23 were within USEPA and CTDEP acceptable levels for the RME and CTE scenarios.

- Cancer risks for adult residents exposed to groundwater at Site 23 were less than or within USEPA's target risk range and less than CTDEP's acceptable risk level for cumulative exposures. The chemical-specific cancer risk for PCE exceeded CTDEP's target level of 1×10^{-6} for individual chemicals; however, the maximum detected concentration for tetrachloroethene was less than its CTDEP RSR.

- Because groundwater at Site 23 is not used for human consumption and it is not likely to be used for human consumption in the foreseeable future because of its current classification (i.e., GB groundwater which indicates that it is unsuitable for direct human consumption without treatment), it was determined that an FS was not warranted. However, it was recommended that the decision for preparation of an FS for Site 23 groundwater be postponed until site conditions stabilize and the results of the metering pit sampling and analysis program are evaluated.

The HHRA conducted for Site 23 groundwater during the BGOURI was re-evaluated in 2008 to determine if changes in EPA and CTDEP risk assessment guidance and recently collected groundwater data (data from quarterly underdrain meter pit sampling) affected the risk assessment conclusions (see Appendix E). The following is a summary of the results of the re-evaluation:

- Changes in risk assessment guidance since the BGOURI did not affect the conclusions of the BGOURI risk assessment.

- During the BGOURI, the chemical-specific cancer risk for PCE exceeded CTDEP's target level for individual chemicals, although the maximum detected concentration was less than the CTDEP RSR. Concentrations of tetrachloroethene decreased from 3 µg/L during the BGOURI to 0.4 µg/L during September 2007 metering pit sampling. The chemical-specific risk associated with tetrachloroethene is now less than the CTDEP target level for individual chemicals.

- Concentrations of all chemicals detected in groundwater collected during the first four quarters of underdrain metering pit sampling were less than CTDEP surface water protection and volatilization criteria with the exception of arsenic and several SVOCs. The concentration of total arsenic in the sample collected in September 2007 exceeded the surface water protection criterion, although the concentration of arsenic in the filtered sample was less than the criterion. Arsenic detected in the

unfiltered sample is believed to be a result of suspended solid particles in the water, and the filtered sample is more indicative of groundwater quality. Concentrations of six PAHs and hexachlorobenzene exceeded surface water protection criteria in December 2007; however, these chemicals were not detected in the duplicate sample and were not detected in February 2008.

- Potential risks for construction workers exposed to Site 23 groundwater would still be acceptable using the analytical results from the most recent rounds of groundwater sampling. Potential risks for hypothetical residents exposed to Site 23 groundwater exceed acceptable levels, but Site 23 is not suitable for residential development (based on petroleum cleanup to industrial standards and GB groundwater classification).

- The vapor intrusion evaluation for Site 23 groundwater determined that risks from vapor intrusion did not exceed EPA and CTDEP acceptable levels for residential and industrial scenarios. The evaluation concluded that no further action was required for vapor intrusion issues at Site 23.

- Based on existing information, Site 23 groundwater does not pose a significant threat to human health or the environment under current and expected future land use. Adverse health effects are possible under hypothetical future residential land use.

2.7.2 Summary of Ecological Risk Assessment

An ERA for Site 3 groundwater at the NSA was performed for the BGOURI Update/FS. A summary of this ERA is presented in the following subsections. Ecological risks for the remaining portions of Site 3 and Sites 7, 14, and 20 were evaluated during the Phase II RI. Groundwater was not identified as an ecological issue at those sites. No ecological risk assessments were performed at Sites 15 or 18 because there were no ecological issues identified at the sites. Site 15 is located within a paved parking area and Site 18 is a building. Both sites are in well developed portions of NSB-NLON and neither provide habitats suitable for supporting a wildlife population.

2.7.2.1 Site 2

The Area A Landfill, Site 2A, currently represents generally limited habitat due to the pavement covering the landfill and its proximity to areas of high human activity (e.g., Area A Weapons Center). Site 2A does border areas that represent potential wildlife habitat or may provide cover for ecological receptors. An ecological risk assessment was conducted as part of the Phase II RI (conducted in 1993 and 1994) and considered site conditions prior to construction of the landfill cap in 1997. Based on conditions after capping, the Phase II RI concluded that the Area A Landfill represents little potential risk to ecological receptors.

Exposure of ecological receptors to groundwater or surface water affected by groundwater was not expected and was therefore not evaluated in the ecological risk assessment for Site 2A. Groundwater from Site 2A discharges to surface water in the Area A Wetland (Site 2B), and surface water contamination at Site 2B was evaluated in the ecological risk assessment for this site, which was also conducted as part of the Phase II RI.

Using conservative exposure assumptions, maximum and average chemical concentrations in surface water, sediment, and soil at Site 2B were compared to benchmark values protective of various terrestrial and aquatic receptors. The results of these comparisons indicated that chemicals associated with these media at Site 2B could adversely impact aquatic biota, terrestrial vegetation, soil invertebrates, and terrestrial vertebrates. These risks are being evaluated and will be addressed as necessary under OU12, Site 2B sediment, as part of the Phase III RI.

2.7.2.2 Site 3

Introduction

The goal of the ERA was to determine whether adverse ecological impacts are present as a result of exposure to chemicals released to the environment at Site 3 - NSA. The ERA methodology used was the Final Guidelines for Ecological Risk Assessment (EPA, 1998), the Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA, 1997), and Navy Policy for Conducting Ecological Risk Assessments (Navy, 1999b). The ERA consisted of Steps 1, 2, and 3a of the ERA process. A summary of the ERA conducted for the groundwater at Site 3 is provided below.

Exposure Assessment

A general description of Site 3 is presented in Section 2.5 of this ROD. Site 3 – NSA, located adjacent to Stream 5 in the northern portion of Site 3, is very small and consists primarily of a steep embankment. The embankment slopes to an intermittent stream (Stream 5) separated from Triton Road by a narrow strip of grassed land (approximately 10 to 15 feet wide). The embankment is covered by large rocks, boulders, and small trees. Figure 2-20 presents the conceptual site model. In summary, the primary source of contamination was assumed to originate at the surface. It is likely that the contamination migrated through the soil to groundwater. In addition, contamination that migrated to groundwater could have discharged to Stream 5. There is also a possibility that contamination could have migrated to Stream 5 sediment as a result of erosion of the embankment. Ecological receptors can be exposed to

contaminants in the surface water, sediment, and surface soil by direct exposure, ingestion of media, and ingestion of contaminated food items.

Assessment and Measurement Endpoints

For the ERA, the assessment endpoint associated with exposure to groundwater included the protection of aquatic invertebrates from a reduction in growth, survival, and/or reproduction caused by site-related chemicals.

The following measurement endpoint was used to evaluate the assessment endpoint in this ERA:

- Decreases in survival, growth, and/or reproduction of aquatic invertebrates were evaluated by comparing the measured concentrations of chemicals in the groundwater to surface water screening values designed to be protective of these ecological receptors. Groundwater sample concentrations were compared to surface water screening values as a conservative measure to evaluate the potential migration pathway of groundwater discharge to Stream 5.

Identification of Chemicals of Potential Concern

Potential risks to aquatic receptors resulting from exposure to chemicals were evaluated by comparing the chemical concentrations in the groundwater to screening levels. Table 2-18 presents the sources of the screening levels. An ecological effects quotient (EEQ) approach was used to characterize the risk to potential ecological receptors. This approach characterizes potential effects by comparing exposure concentrations to effects data. The EEQs for aquatic receptors were calculated as follows:

$$EEQ = \frac{C_{sw}}{SwSV}$$

where:

EEQ = Ecological effects quotient (unitless)
C_{sw} = Contaminant concentration in surface water (µg/L or mg/L)
SwSV = Surface water receptor screening value (µg/L)

Ecological COPCs were selected by the following procedures:

- Chemicals with EEQs greater than 1.0 (using maximum concentrations) were retained as COPCs for further evaluation because they have a potential to cause risk to ecological receptors.

- Contaminants without screening levels were retained as COPCs but were only evaluated qualitatively.

One VOC, five SVOCs, seven total metals, and three filtered metals were retained as COPCs in groundwater for the potential future exposure scenario of migration to surface water in Stream 5 (Table 2-18). Benzo(a)pyrene, aluminum, barium, copper, iron, lead, and manganese were retained as COPCs because their maximum concentrations exceeded associated surface water screening values (SwSVs). All other chemicals were retained as COPCs because no toxicity information was available for comparison.

Step 3A – Refinement of Conservative Exposure Assumptions

Step 3a consists of a refinement of the conservative exposure assumptions used to select COPCs to more realistically estimate potential risks to ecological receptors. This refinement is qualitative in nature and discusses items such as habitat, exposure concentrations, and alternate benchmarks. The chemicals discussed in the following paragraphs were retained as COPCs because their maximum detections in groundwater exceeded SwSVs or because SwSVs were not available for comparison.

VC was retained as a COPC because no SwSV was available for comparison to the maximum groundwater concentration. It should be noted, however, that VOCs are typically not detected in surface water samples due to their high degree of volatility. Also, based on SwSVs for the other VOCs, VC is not expected to be detected in groundwater at sufficient concentrations to cause ecological risks to aquatic receptors if discharged to Stream 5. VC was not retained as a COC.

Benzo(a)pyrene was retained as a COPC because the single detected concentration exceeded the conservative SwSV. However, the SwSV seems overly conservative when compared to SwSVs for other PAHs from different sources (e.g., SwSV for acenaphthene is 23 µg/L, SwSV for fluorene is 3.9 µg/L). Additionally, benzo(a)pyrene was detected in only one of five groundwater samples (i.e., the sample from 3TW28). At such a low groundwater concentration, it is unlikely that benzo(a)pyrene would be detected in surface water upon discharge to Stream 5 due to dilution. Benzo(a)pyrene and other PAHs were also detected in the surface soil sample from this location indicating that its presence in groundwater may be attributable to a lack of proper development (turbidity) in this temporary well. Benzo(a)pyrene was not retained as a COC.

Benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were retained as COPCs because no individual SwSVs were available for comparison. Alternate surface water benchmarks for these PAHs could not be located; therefore, further evaluation of these chemicals was not possible. However, these chemicals were only detected in one of five groundwater samples (i.e., the

sample from 3TW28). As with benzo(a)pyrene, these PAHs are unlikely to be detected in surface water upon discharge to Stream 5 due to dilution. These PAHs were also detected in the surface soil sample from this location indicating their presence in groundwater may be attributable to a lack of proper development in this temporary well. For these reasons, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were not retained as COCs.

Aluminum, barium, copper, iron, lead, and manganese in total metals samples were retained as COPCs because their maximum detected concentrations in groundwater exceeded corresponding SwSVs. Barium, iron, and manganese were additionally retained as COPCs in filtered metals samples because their maximum filtered groundwater concentrations exceeded associated SwSVs. Vanadium was additionally retained as a COPC because an SwSV was not available for comparison (see Table 2-18).

Aluminum, copper and lead were detected at maximum concentrations in unfiltered groundwater samples that exceeded their respective SwSVs. Vanadium was detected at a maximum concentration that slightly exceeded background. Aluminum, copper, lead, and vanadium were not detected in filtered samples, however, and detections of these metals in unfiltered samples could be attributable to a lack of proper development of the temporary wells. Only concentration levels that occur in filtered samples are considered to be bioavailable to aquatic organisms. For these reasons, these metals are not likely to be present in groundwater at concentrations that would present unacceptable risks to aquatic receptors after migration to surface water. Aluminum, copper, lead, and vanadium were not retained as COCs.

Barium was detected at a maximum concentration of 74.8 µg/L in unfiltered groundwater sample S3GW3TW3001, exceeding the SwSV of 4 µg/L. However, the background concentration of 227 µg/L is nearly three times greater than the maximum groundwater detection, indicating that barium concentrations are naturally occurring and not likely attributable to a contamination source. Barium was also detected in filtered samples at a maximum concentration of 75.6 µg/L, well below the background filtered concentration of 124 µg/L. For these reasons, site-related risks from barium are not considered likely, and barium was not retained as a COC.

Iron was detected at a maximum concentration of 20,000 µg/L in unfiltered groundwater sample S3GW3TW2801, exceeding the SwSV of 1,000 µg/L. However, the maximum concentration is less than the unfiltered background concentration of iron at 28,200 µg/L. Iron was also detected in filtered samples at a maximum concentration of 15,200 µg/L, well below the background filtered concentration of 25,300 µg/L. For these reasons, site-related risks from iron are not considered likely, and iron was not retained as a COC.

Manganese was detected at a maximum concentration of 764 µg/L in groundwater sample S3GW3TW2701, exceeding the SwSV of 120 µg/L. However, the background manganese concentration of 11,700 µg/L is nearly 15 times greater than the maximum detected groundwater concentration. Additionally, manganese was detected in filtered samples at a maximum concentration of 496 µg/L, well below the background filtered concentration of 9,400 µg/L. For these reasons, site-related risks from manganese are not considered likely, and manganese was not retained as a COC.

Summary and Conclusions of Site 3 ERA

Several chemicals detected in groundwater were initially retained as COPCs because their chemical concentrations exceeded screening levels resulting in EEQs greater than 1.0 based on conservative exposure scenarios. These chemicals were then re-evaluated in Step 3a of the ERA to determine which chemicals have the greatest potential for causing risks to ecological receptors, and therefore, should be retained as COCs for further discussion and evaluation. The ecological endpoints evaluated in this ERA were aquatic receptors. In summary, no chemicals were retained as ecological COCs.

2.7.2.3 Site 23

An ecological risk assessment was not conducted for Site 23 groundwater because there are no ecological receptors for groundwater at the site.

2.8 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) provide a general description of what the response actions will accomplish. These goals typically serve as the design basis for many of the remedial alternatives discussed in the next section. The RAOs provide the basis for evaluating remedial options for Sites 3 and 7 groundwater and an understanding of how the risks identified in the previous section will be addressed by the response actions. No RAOs were necessary for Sites 2, 9, 14, 15, 18, 20, and 23 because there were no unacceptable risks and therefore no remedial actions proposed for the sites.

RAOs were developed to address the COCs detected exclusively at Site 3 (VC) and the COCs detected at both Sites 3 and 7 (TCE and HCB). Separate RAOs were developed to address the COCs detected at Site 7 exclusively (1,4-DCB, benzene, and CB).

2.8.1 Sites 3 and 7 Groundwater RAOs

Sites 3 and 7 groundwater RAOs are as follows:

- RAO A-1: To protect current receptors (construction workers) from incidental exposure to groundwater contaminated with chlorinated hydrocarbons at concentrations greater than PRGs.

- RAO A-2: To protect potential future receptors from regular ingestion (potable water supply) of groundwater contaminated with chlorinated hydrocarbons at concentrations greater than RGs (see Tables 2-19 and 2-20) and to protect future residential receptors from exposure to contaminated groundwater via vapor intrusion (Site 3 only).

- RAO A-3: To protect aquatic ecological receptors by preventing the migration of groundwater contaminated with petroleum hydrocarbons at concentrations greater than PRGs to surface water.

2.8.2 Site 7 Groundwater RAOs

Site 7 groundwater RAOs are as follows:

- RAO B-1: Protect current receptors (construction workers) from incidental exposure to groundwater contaminated with organics at concentrations greater than PRGs.

- RAO B-2: Protect potential future receptors from regular ingestion (potable water supply) of groundwater contaminated with benzene and chlorinated hydrocarbons at concentrations greater than RGs.

- RAO B-3: Protect aquatic ecological receptors by preventing the migration of groundwater contaminated with COCs at concentrations greater than PRGs to surface water.

RGs for the protection of potential future receptors are presented in Tables 2-19 and 2-20 for Sites 3 and 7, respectively.

2.8.3 Sites 9 and 23 Groundwater RAOs

RAOs for groundwater at Sites 9 and 23 are as follows:

- RAO C-1: Protect potential future receptors from exposure to contaminated groundwater via ingestion (potable water supply).

- RAO C-2: Protect aquatic ecological receptors.

2.9 DESCRIPTION OF ALTERNATIVES

Separate FSs were prepared to evaluate remedial alternatives for the groundwater contamination identified jointly at Sites 3 and 7 and the groundwater contamination identified exclusively at Site 7. One FS involved development and evaluation of alternatives that would address the COCs detected exclusively at Site 3 (VC) and the COCs detected jointly at Sites 3 and 7 (TCE and HCB). The other FS involved preparation and evaluation of alternatives that addressed the COCs detected exclusively at Site 7 (1,4-DCB, benzene, and CB). No FSs were prepared for Sites 14, 15, 18, and 20 because there were no unacceptable risks and therefore no COCs for the sites. Groundwater at Sites 2A and 2B is currently monitored under the post-closure groundwater monitoring program implemented as part of the remedy for OU1 as required by the September 1995 ROD (Navy, 1995). Institutional controls will remain in place at Sites 2A and 2B as described in the NSB-NLON IR Site Use Restrictions document.

2.9.1 Description of Remedial Alternatives

2.9.1.1 Sites 3 and 7 Groundwater

Alternatives were formulated from the technologies and process options that passed the screening process. The two alternatives selected for detailed evaluation in the FS for combined Sites 3 and 7 groundwater included Alternative GW1-1 (No Action) and Alternative GW1-2 (Institutional Controls with Monitoring). Alternative GW1-1 was evaluated for comparison purposes, and the other alternative was evaluated because of site conditions (generally low concentrations of contaminants, groundwater not classified as a suitable potable water source, and the availability and use of a public water supply) and its ability to meet the RAOs. Active remedial alternatives (e.g., pump and treat) were not considered for Sites 3 and 7 groundwater because they are not effective for the site conditions discussed above.

Alternative GW1-1: No Action

Under this alternative, no activities other than mandatory five-year reviews would be conducted at the sites. The No Action Alternative for groundwater is not expected to be fully protective of human health and the environment. In particular, even though site groundwater is classified as GB, indicating that it is not suitable for regular human consumption, it could potentially be reclassified and used in the future as a potable water supply. Based on the concentrations and sporadic distribution of site groundwater contamination, these risks are possible but not very likely. Also, if groundwater is encountered and removed during construction projects, contaminated groundwater could be discharged to adjacent streams. Based on the concentrations and distribution of groundwater contamination, potential impact to aquatic ecological receptors may not be significant, but potential risks would not be known. This alternative will be retained to serve as a basis for evaluating other alternatives.

- Estimated Time for Design and Construction: NA
- Estimated Time for Operation: 30 years
- Estimated Capital Cost: $0
- Estimated O&M Costs (Present Worth): $89,600
- Estimated Total Present Worth: $89,600

Alternative GW1-2: Institutional Controls with Monitoring

This alternative was developed to protect human health by placing restrictions on groundwater extraction and use at the sites. Under this alternative, institutional controls would be implemented to prohibit the placement of groundwater extraction wells in or use of groundwater from this area without first testing the groundwater. Also, if groundwater is encountered and removed during construction projects (e.g., trench dewatering), the groundwater would have to be characterized and properly handled, discharged, or disposed.

The NSB-NLON IR Site Use Restrictions document would note the location and types of groundwater contamination observed at the sites. Future commercial land use would be permitted as long as institutional controls are maintained. However, at Site 3, construction of a building for residential purposes would be prohibited within 100 feet of well location 2DMW29S unless steps are taken to mitigate vapor intrusion (e.g., subslab depressurization system). In the event of property transfer and with confirmation that contaminated groundwater remains at the sites, an environmental land use restriction pursuant to state law would be used to prohibit the use of groundwater. Compliance monitoring to determine whether there are any violations of institutional control restrictions would also occur.

New and existing monitoring wells would be used to monitor the natural degradation of VOC and SVOC contaminants. Monitoring would continue until contaminant concentrations have decreased below the PRGs and the resulting concentrations are shown to be protective of human health and the environment.

- Estimated Time for Design and Construction: 6 months
- Estimated Time for Operation: 30 years
- Estimated Capital Cost: $59,200
- Estimated O&M Costs (Present Worth): $260,300
- Estimated Total Present Worth: $319,500

2.9.1.2 Site 7 Groundwater

Alternatives were formulated from the technologies and process options that passed the screening process. The three alternatives selected for detailed evaluation in the FS for Site 7 groundwater included Alternative GW2-1 (No Action), Alternative GW2-2 (Institutional Controls with Monitoring), and Alternative GW2-3 (Extraction and Off-Site Discharge). Alternative GW2-1 was evaluated for comparison purposes, and the other alternatives were evaluated because of site conditions and their ability to meet the RAOs for Site 7 groundwater.

Alternative GW2-1: No Action

Under this alternative, no activities other than mandatory five-year reviews would be conducted at this site. The No Action Alternative for groundwater is not expected to be fully protective of human health and the environment. In particular, even though site groundwater is classified as GB, indicating that it is not suitable for regular human consumption, it could potentially be used in the future as a potable water supply. Also, if groundwater is encountered and removed during construction projects, contaminated groundwater could be discharged to adjacent streams and potentially impact aquatic ecological receptors. However, this alternative will be retained to serve as a basis for evaluating other alternatives.

- Estimated Time for Design and Construction: NA
- Estimated Time for Operation: 30 years
- Estimated Capital Cost: $0
- Estimated O&M Costs (Present Worth): $89,600
- Estimated Total Present Worth: $89,600

Alternative GW2-2: Institutional Controls with Monitoring

This alternative was developed to protect human health and the environment by placing restrictions on extraction and use of groundwater at this site. Under this alternative, institutional controls would be implemented to prohibit the placement of groundwater extraction wells in or use of groundwater from this area. If groundwater is encountered and removed during construction projects (e.g., trench dewatering), the groundwater would have to be characterized and properly disposed.

The NSB-NLON IR Site Use Restrictions document would note the location and types of contamination observed at the site. Future commercial or residential land use would be permitted as long as institutional controls are maintained. In the event of property transfer and with confirmation that contaminated groundwater remains at the site, an environmental land use restriction pursuant to state law would be

used to prohibit the use of groundwater. Compliance monitoring to determine whether there are any violations of institutional control restrictions would also occur.

New and existing monitoring wells would be used to monitor the natural degradation of VOC and SVOC contaminants. Monitoring would continue until contaminant concentrations have decreased below the PRGs and the resulting concentrations are shown to be protective of human health and the environment.

- Estimated Time for Design and Construction: 6 months
- Estimated Time for Operation: 30 years
- Estimated Capital Cost: $59,700
- Estimated O&M Costs (Present Worth): $244,100
- Estimated Total Present Worth: $303,800

Alternative GW2-3: Extraction and Off-Site Discharge

This alternative was developed to protect human health and the environment by extracting all contaminated groundwater (approximately 1,250,000 gallons) through one groundwater extraction well and discharging the water to the Groton publicly owned treatment works (POTW) for treatment. Based on the level of contamination found, pre-treatment of the water is not expected. However, if pre-treatment is necessary, filtration and granular activated carbon (GAC) adsorption could be considered. If implemented, the alternative would represent a clean closure for groundwater at the site with no long-term requirements.

Additional temporary and permanent monitoring wells would be installed to better define the extent of groundwater contamination and to monitor groundwater contaminant capture and cleanup. Collected data would be used to characterize groundwater for treatment needs, if any, and discharge requirements.

- Estimated Time including Design and Completion: 1.5 years
- Estimated Capital Cost: $1,018,600
- Estimated O&M Costs (Present Worth): $105,500
- Estimated Total Present Worth: $1,121,000

2.9.1.3 Sites 9 and 23 Groundwater

The two alternatives evaluated for Sites 9 and 23 groundwater included Alternative GW3-1 (No Action) and Alternative GW3-2 (Institutional Controls). Active groundwater remedial technologies were not evaluated because of the absence of a contaminant plume and other site conditions (generally low concentrations of contaminants, groundwater not classified as a suitable potable water source, and

availability and use of a public water supply). Alternative GW3-1 was evaluated for comparison purposes and Alternative GW3-2 was evaluated because of site conditions and its ability to meet the RAOs.

Alternative GW3-1: No Action

Under this alternative, no activities other than mandatory five-year reviews would be conducted at this site. The No Action Alternative for groundwater is not expected to be fully protective of human health and the environment. In particular, even though site groundwater is classified as GB, indicating that it is not suitable for regular human consumption, it could potentially be used in the future as a potable water supply. Also, if groundwater is encountered and removed during construction projects, contaminated groundwater could be discharged to adjacent streams and potentially impact aquatic ecological receptors. However, this alternative will be retained to serve as a basis for evaluating the other alternative.

- Estimated Time for Design and Construction: NA
- Estimated Time for Operation: 30 years
- Estimated Capital Cost: $0
- Estimated O&M Costs (Present Worth): $89,600
- Estimated Total Present Worth: $89,600

Alternative GW3-2: Institutional Controls

This alternative was developed to protect human health and the environment by placing restrictions on extraction and use of groundwater at this site. Under this alternative, institutional controls would be implemented to prohibit the placement of groundwater extraction wells in or use of groundwater from this area. If groundwater is encountered and removed during construction projects (e.g., trench dewatering), the groundwater would have to be characterized and properly disposed.

The NSB-NLON IR Site Use Restrictions document would note the location and types of contamination observed at the site. Future commercial or residential land use would be permitted as long as institutional controls are maintained. In the event of property transfer and with confirmation that contaminated groundwater remains at the site, an environmental land use restriction pursuant to state law would be used to prohibit the use of groundwater. Compliance monitoring to determine whether there are any violations of institutional control restrictions would also occur.

- Estimated Time for Design and Construction: 6 months
- Estimated Time for Operation: 30 years
- Estimated Capital Cost: $10,295
- Estimated O&M Costs (Present Worth): $108,705

- Estimated Total Present Worth: $119,000

2.9.2 Common Elements and Distinguishing Features of Each Alternative

2.9.2.1 Sites 3 and 7 Groundwater

Alternatives GW1-1 and GW1-2 are similar in that neither of the alternatives would actively treat the contaminated groundwater. Ultimately, site contaminants would be expected to degrade through natural biological, chemical, and physical processes. For Alternative GW1-1, no action would be taken except mandatory five-year site reviews.

Both Alternatives GW1-1 and GW1-2 allow the contaminated groundwater to remain in place, but Alternative GW1-2 includes institutional controls to restrict extraction and use of groundwater, monitoring at predetermined intervals until contaminant concentrations have decreased to less than PRGs and the resulting concentrations are shown to be protective of human health and the environment, and periodic site reviews that would be conducted every 5 years. Alternative GW1-2 would address the exposure pathways and risk issues with Sites 3 and 7 groundwater but would not open the sites for unrestricted future use.

2.9.2.2 Site 7 Groundwater

Alternatives GW2-1 and GW2-2 are similar in that neither of the alternatives would actively treat the contaminated groundwater. Ultimately, site contaminants would be expected to degrade through natural biological, chemical, and physical processes. For Alternative GW2-1, no action would be taken except mandatory five-year site reviews.

Alternatives GW2-1 and GW2-2 allow the contaminated groundwater to remain in place, but Alternative GW2-2 includes institutional controls to restrict extraction and use of groundwater, monitoring at predetermined intervals until contaminant concentrations have decreased to less than PRGs and the resulting concentrations are shown to be protective of human health and the environment, and periodic site reviews that would be conducted every 5 years.

Alternatives GW2-2 and GW2-3 are similar in that they both address the exposure pathways. However, Alternative GW2-2 addresses the exposure pathways associated with Site 7 groundwater by controlling construction and development activities, and Alternative GW2-3 addresses the exposure pathways by removing the contaminated groundwater and sending it to a POTW for treatment. Both alternatives address the risk issues with Site 7 groundwater, but Alternative GW2-3 opens the site for unrestricted future use.

Alternative GW2-3 is the alternative that provides active remediation of Site 7 groundwater. Alternative GW2-2, a passive alternative that allows for natural degradation of site contaminants, includes periodic inspection of compliance with institutional controls and monitoring.

2.9.2.3 Sites 9 and 23 Groundwater

Alternatives GW3-1 and GW3-2 are similar in that neither of the alternatives would actively treat the contaminated groundwater. For Alternative GW3-1, no action would be taken except mandatory five-year site reviews. Both Alternatives GW3-1 and GW3-2 allow contaminated groundwater to remain in place, but Alternative GW3-2 includes institutional controls to restrict extraction and use of groundwater and periodic site reviews that would be conducted every 5 years. Alternative GW3-2 would address the exposure pathways and risk issues with Sites 9 and 23 groundwater but would not open the sites for unrestricted future use.

2.9.3 Expected Outcomes of Each Alternative

2.9.3.1 Sites 3 and 7

Under Alternatives GW1-1 (No Action) and GW1-2 (Institutional Controls with Monitoring), Sites 3 and 7 could not be released for unrestricted use. In the event that the sites were released for unrestricted use, Alternative GW1-1 would not be protective of human health for potential future receptors. Institutional controls would be implemented to restrict extraction and use of groundwater at Sites 3 and 7 under Alternative GW1-2 until the contaminants in groundwater naturally degrade to concentrations less than the selected PRGs and the resulting concentrations are shown to be protective of human health and the environment.

2.9.3.2 Site 7

Under Alternatives GW2-1 (No Action) and GW2-2 (Institutional Controls with Monitoring), Site 7 could not be released for unrestricted use. In the event that the site was released for unrestricted use, Alternative GW2-1 would not be protective of human health for potential future receptors. Institutional controls and monitoring would be implemented to restrict extraction and use of groundwater at Site 7 under Alternative GW2-2 until the contaminants in groundwater naturally degrade to concentrations less than the selected PRGs and the resulting concentrations are shown to be protective of human health and the environment.

After implementation of Alternative GW2-3 (Extraction and Off-Site Discharge), Site 7 would be released for unrestricted use. Under this alternative, human health and the environment would be protected

because the contaminated groundwater would be extracted from the site, treated as necessary, and discharged.

2.9.3.3 Sites 9 and 23

Under Alternatives GW3-1 (No Action) and GW3-2 (Institutional Controls), Sites 9 and 23 could not be released for unrestricted use. In the event that the sites were released for unrestricted use, Alternative GW3-1 would not be protective of human health for potential future receptors. Institutional controls would be implemented to restrict extraction and use of groundwater at Sites 9 and 23 under Alternative GW3-2 until contaminants concentrations are shown to be protective of human health and the environment.

2.10 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section of the ROD summarizes the comparative analysis of alternatives presented in the detailed analysis sections of the two FS Reports. The major objective is to evaluate the relative performance of the alternatives with respect to the nine evaluation criteria so that the advantages and disadvantages of each are clearly understood. The first two evaluation criteria, Overall Protection of Human Health and the Environment and Compliance with ARARs are threshold criteria that must be satisfied by any remedial alternative chosen for the site. The primary balancing criteria are then considered to determine which alternative provides the best combination of attributes. The primary balancing criteria are as follows:

- Long-term effectiveness and permanence
- Reduction in toxicity, mobility, or volume through treatment
- Implementability
- Short-term effectiveness
- Cost

The alternatives are evaluated further against the following two modifying criteria:

- Acceptance by the state
- Acceptance by the community

2.10.1 Overall Protection of Human Health and the Environment

2.10.1.1 Sites 3 and 7

The No Action Alternative, GW1-1, would not be protective of human health or the environment. Under this alternative, without monitoring or institutional controls, contamination would remain at the site without

adequate notification. Groundwater could potentially be used for human consumption in a future residential scenario (RAO A-2), could be extracted and discharged during construction activities (e.g. excavation dewatering), and/or could migrate without degradation to a local stream and impact ecological receptors (RAO A-3). Based on existing characterization, groundwater is not anticipated to represent a significant risk to current receptors (construction workers) through incidental contact (RAO A-1) or to ecological receptors through migration (RAO A-3).

Under Alternative GW1-2, Institutional Controls with Monitoring, potential future risks associated with groundwater would be addressed by restricting a future residential scenario (RAO A-1), providing requirements for groundwater that could be extracted and discharged during construction activities (e.g., excavation dewatering), and monitoring the migration and natural degradation of groundwater contaminants (RAO A-3). Based on existing characterization, groundwater is not anticipated to represent a significant risk to current receptors (construction workers) through incidental contact (RAO A-2) or to ecological receptors through migration (RAO A-3).

The groundwater is currently classified as GB, groundwater concentrations are relatively low and sporadic or the magnitude of PRG exceedances are minor, and the sites are under military control. As a result, the potential for significant impact to human health and the environment is low. In addition, public potable water is available and used in the area, and local groundwater resources are not normally considered for use. Also, the COCs in Sites 3 and 7 groundwater are organic and are subject to slow natural biological and chemical degradation. Without active cleanup, groundwater concentrations should decrease to less than PRGs, but several years to several decades may be required.

2.10.1.2 Site 7

The No Action Alternative, GW2-1, would not be protective of human health or the environment. Under this alternative, without monitoring or institutional controls, contamination would remain at the site without adequate notification. Groundwater could be used for human consumption in a future residential scenario (RAO B-2), could be extracted and discharged during construction activities (e.g., excavation dewatering), and/or could migrate without degradation to a local stream and impact ecological receptors (RAO B-3). Based on existing characterization, groundwater is not anticipated to represent a significant risk to current receptors (construction workers) through incidental contact (RAO B-1) or to ecological receptors through migration (RAO B-3).

Under Alternative GW2-2, Institutional Controls with Monitoring, potential future risks associated with groundwater would be addressed by restricting a future residential scenario (RAO B-1), providing requirements for groundwater that could be extracted and discharged during construction activities (e.g., excavation dewatering), and monitoring the migration and natural degradation of groundwater

contaminants (RAO B-3). Based on existing characterization, groundwater is not anticipated to represent a significant risk to current receptors (construction workers) through incidental contact (RAO B-2) or to ecological receptors through migration (RAO B-3).

The groundwater is currently classified as GB, groundwater concentrations are relatively low level and sporadic or the magnitude of PRG exceedances are minor, and the site is under military control. As a result, the potential for significant impact to human health and the environment is low. In addition, public potable water is available and used in the area and local groundwater sources are not normally considered for use. Also, the COCs in Site 7 groundwater are organic and are subject to slow natural biological and chemical degradation. Without active cleanup, groundwater concentrations should decrease to less than PRGs, but several years to several decades may be required.

For Site 7, Alternative GW2-3 would protect human health and the environment by removing contaminated groundwater from the site, pre-treating the extracted water, if necessary, and discharging the water to the POTW for final treatment and discharge. Groundwater monitoring would be completed to monitor groundwater contaminant capture and cleanup. After removal of the contaminated groundwater from the site, there would be no remaining risks associated with Site 7 groundwater.

2.10.1.3 Sites 9 and 23

The No Action Alternative is not protective of human health or the environment. Under this alternative, without institutional controls, contamination would remain at the site without adequate notification. Groundwater could potentially be used for human consumption in a future residential scenario (RAO C-1), could be extracted and discharged during construction activities (e.g. excavation dewatering), and/or could migrate without degradation to a local stream and impact ecological receptors (RAO C-2). Based on existing characterization, groundwater is not anticipated to represent a significant risk to current receptors (construction workers) through incidental contact or to ecological receptors through migration.

Under Alternative GW3-2, Institutional Controls, potential future risks associated with groundwater would be addressed by restricting a future residential scenario (RAO C-1) and providing requirements for groundwater that could be extracted and discharged during construction activities (e.g., excavation dewatering). Based on existing characterization, groundwater is not anticipated to represent a significant risk to current receptors (construction workers) through incidental contact or to ecological receptors through migration.

The groundwater is currently classified as GB, groundwater concentrations are relatively low and sporadic, and the sites are under military control. As a result, the potential for significant impact to human

health and the environment is low. In addition, public potable water is available and used in the area, and local groundwater resources are not normally considered for use.

2.10.2 Compliance with ARARs

Section 121(d) of CERCLA and the NCP, 40 CFR 300.430(f)(1)(ii)(B), require that RAs at CERCLA sites at least attain legally applicable or relevant and appropriate federal environmental rules, regulations, and criteria, and state environmental and facility siting statutes, regulations, and requirements, unless such ARARs are waived under CERCLA section 121(d)(4).

2.10.2.1 Sites 3 and 7

An assessment of ARARs and To Be Considereds (TBCs) for Alternative GW1-1 is provided in Table 2-21. The No Action Alternative would not comply with chemical-specific ARAR or TBCs. Considering TBCs, the No Action Alternative would result in unacceptable risks from exposure to contaminated groundwater. No restrictions on groundwater use would be implemented under the alternative, and future groundwater use could result in unacceptable risks to receptors. Location- and action-specific ARARs are not applicable to Alternative GW1-1.

An assessment of ARARs and TBCs for Alternative GW1-2 is provided in Tables 2-22, 2-23, and 2-24. This alternative would comply with all chemical-specific ARARs and TBCs. Institutional Controls would be established for the active base through the NSB-NLON IR Site Use Restriction document. If the Navy was to transfer ownership of the property, the institutional controls would be established through environmental land use restrictions, pursuant to state law, that would prevent use of contaminated groundwater. Monitoring of compliance with institutional controls would also be required.

Even though contaminants in site groundwater currently exceed groundwater quality standards (Class GA), site groundwater is classified as GB. GA groundwater quality should ultimately be obtained through natural degradation. Monitoring would be used to track this decrease until concentrations are less than acceptable levels. This alternative would meet chemical-specific TBCs by preventing exposure to contaminated groundwater until concentrations are below acceptable levels that meet human health concerns. This alternative would also comply with all action-specific ARARs. Monitoring would continue until concentrations are less than acceptable levels that meet human health concerns. Any waste (soil or groundwater) generated during the installation of monitoring wells or monitoring activities will be properly characterized and disposed. Because the sites are in a coastal zone management area, activities associated with this alternative would meet the substantive requirements of location-specific ARARs.

2.10.2.2 Site 7

An assessment of ARARs and TBCs for Alternative GW2-1 is provided in Table 2-21. The No Action Alternative would not comply with chemical-specific ARARs and TBCs. Considering TBCs, the No Action Alternative would result in unacceptable risks from exposure to contaminated groundwater. No restrictions on groundwater use would be implemented under the alternative, and future groundwater use could result in unacceptable risks to receptors. Location- and action-specific ARARs are not applicable to Alternative GW2-1.

An assessment of ARARs and TBCs for Alternative GW2-2 is provided in Tables 2-22, 2-23, and 2-24. This alternative should comply with all chemical-specific ARARs and TBCs. Institutional controls would be established for the active base through the NSB-NLON IR Site Use Restriction document. If the Navy was to transfer ownership of the property, the institutional controls would be established through environmental land use restrictions, pursuant to state law, that would prevent use of contaminated groundwater. Monitoring of compliance with institutional controls would also be required.

Even though contaminants in site groundwater currently exceed groundwater quality standards (Class GA), site groundwater is classified as GB. GA groundwater quality should ultimately be obtained through natural degradation. Monitoring would be used to track this decrease until concentrations are below acceptable levels. This alternative would meet chemical-specific TBCs by preventing exposure to contaminated groundwater until concentrations are below acceptable levels that meet human health concerns. This alternative would also comply with all action-specific ARARs. Monitoring would continue until concentrations are less than acceptable levels that meet human health concerns. Any waste (soil or groundwater) generated during the installation of monitoring wells or monitoring activities will be properly characterized and disposed. Because Site 7 is in a coastal zone management area, activities associated with this alternative would meet the requirements of location-specific ARARs.

An assessment of ARARs and TBCs for Alternative GW2-3 is provided in Tables 2-25, 2-26, and 2-27. This alternative would comply with all chemical-specific ARARs and TBCs. Site groundwater with contaminant concentrations that currently exceed groundwater quality standards (Class GA) would be removed and there would be no remaining unacceptable risks to human health. Monitoring would be used to track and confirm this cleanup.

Alternative GW2-3 would comply with action-specific ARARs associated with monitoring and the pre-treatment requirements with the Groton POTW. Monitoring would continue until concentrations are below acceptable levels that meet human health concerns. Any waste (soil or groundwater) generated during the installation of monitoring wells or monitoring activities would be properly characterized and disposed. If pre-treatment residues are generated (filter media and GAC), the off-site disposal of this residue would

trigger federal and State solid waste regulations and based on characterization, could trigger hazardous waste regulations. During pre-treatment, these residues would be characterized for hazardous waste properties and recycling value and would be managed accordingly. Location-specific ARARs are not applicable to Alternative GW2-3.

2.10.2.3 Sites 9 and 23

An assessment of ARARs and TBCs for Alternative GW3-1 is provided in Table 2-21. The No Action Alternative would not comply with chemical-specific ARARs and TBCs. Considering TBCs, the No Action Alternative would result in unacceptable risks from exposure to contaminated groundwater. No restrictions on groundwater use would be implemented under the alternative, and future groundwater use could result in unacceptable risks to receptors. Location- and action-specific ARARs are not applicable to Alternative GW3-1.

An assessment of ARARs and TBCs for Alternative GW3-2 is provided in Tables 2-28 and 2-29. This alternative would comply with all chemical-specific ARARs and TBCs. Institutional controls would be established for the active base through the NSB-NLON IR Site Use Restriction document. If the Navy were to transfer ownership of the property, the institutional controls would be established through environmental land use restrictions, pursuant to state law, that would prevent use of contaminated groundwater. Monitoring of compliance with institutional controls would also be required. Even though contaminants in site groundwater currently exceed groundwater quality standards (Class GA), site groundwater is classified as GB. This alternative would meet chemical-specific ARARs and TBCs and action-specific ARARs by preventing exposure to contaminated groundwater until concentrations are less than acceptable levels. Location-specific ARARs are not applicable to Alternative GW3-2.

2.10.3 Long-Term Effectiveness and Permanence

2.10.3.1 Sites 3 and 7

There is an estimated 24,700,000 gallons of contaminated groundwater present at Sites 3 and 7, based on data from the BGOURI Update/FS. VC was detected at a maximum concentration of 31.5 µg/L during the BGOURI sampling events (2000 and 2002), and the corresponding PRG for VC is 1.6 µg/L. TCE (23 µg/L) and HCB (3 µg/L) were also detected during the BGOURI in site groundwater at concentrations greater than their respective PRGs (5 and 1 µg/L, respectively). Groundwater monitoring was initiated in 2006 at the sites, and the Year 1 results, which are discussed in Section 2.5.2.2, have shown that contaminant concentrations are generally decreasing and nearing the PRGs. These results suggest that a limited action alternative (e.g., institutional controls and monitoring) will be an effective and permanent remedy for the sites.

Alternative GW1-1 may not be effective in the long term. Groundwater contaminants could remain at the site for extended periods of time. Groundwater use, handling, and/or discharge would not be restricted. Ultimately, the site contaminants would be expected to degrade through natural biological, chemical, and physical processes. However, the duration and magnitude of contamination would not be monitored, and the residual risks would not be known.

Alternative GW1-2 is expected to be relatively effective in the long term and will ultimately be permanent. The presence of both federal (NSB-NLON institutional controls) and state (groundwater classifications) controls should effectively prevent the use and exposure to contaminated groundwater. Potential migration and degradation of contaminated groundwater would be monitored and the results would be used to identify the need for additional action. Ultimately, it is expected that improvements in groundwater quality would occur, but it would depend on relatively slow natural biological, chemical, and physical processes. The magnitude of residual contamination would be monitored over time, and potential risks associated with the contamination could be quantified.

2.10.3.2 Site 7

At Site 7 alone, there is estimated to be 170,000 gallons of contaminated groundwater, based on data from the BGOURI Update/FS. CB was detected in groundwater at a maximum concentration of 165 µg/L, and the corresponding PRG for CB is 100 µg/L. DCB (90.5 µg/L) and benzene (2 µg/L) were also detected at the site at concentrations greater than PRGs (75 and 1 µg/L, respectively) during the BGOURI. Groundwater monitoring was initiated at Site 7 in 2006, and the results, which are discussed in Section 2.5.2.3, have shown that contaminant concentrations have generally decreased to less than the PRGs. These results suggest that a limited action alternative (e.g., institutional controls and monitoring) will be an effective and permanent remedy for the site.

Alternative GW2-1 may not be effective in the long term. Groundwater contaminants could remain at the site for extended periods of time. Groundwater use, handling, and/or discharge would not be restricted. Ultimately, the site contaminants would be expected to degrade through natural biological, chemical, and physical processes. However, the duration and magnitude of contamination would not be monitored, and the residual risks would not be known

Alternative GW2-2 is expected to be relatively effective in the long term and will ultimately be permanent. The presence of both federal (NSB-NLON institutional controls) and state (groundwater classifications) controls should effectively prevent the use of contaminated groundwater as a potable water supply. Potential migration and degradation of contaminated groundwater would be monitored, and the results would be used to identify the need for additional action. Ultimately, the site contaminants would be

expected to degrade through natural biological, chemical, and physical processes. The magnitude of residual contamination would be monitored over time, and potential risks associated with the contamination could be quantified.

It is estimated that 1,250,000 gallons of groundwater need to be extracted to remove the 170,000 gallons of contaminated groundwater. By removing and treating the Site 7 contaminated groundwater, Alternative GW2-3 would be very effective and permanent. Future monitoring or other actions would not be required. In the unlikely event that a continuing source of contaminants is present, then recontamination of the groundwater could occur.

2.10.3.3 Sites 9 and 23

Alternative GW3-1 may not be effective in the long term. Groundwater contaminants could remain at the site for extended periods of time. Groundwater use, handling, and/or discharge would not be restricted. Alternative GW3-2 is expected to be relatively effective in the long term and will ultimately be permanent. The presence of both federal (NSB-NLON institutional controls) and state (groundwater classifications) controls should effectively prevent the use and exposure to contaminated groundwater.

2.10.4 Reduction of Toxicity, Mobility, or Volume through Treatment

2.10.4.1 Sites 3 and 7

Alternatives GW1-1 and GW1-2 do not use active treatment of site contaminants; therefore, this criterion is not applicable.

2.10.4.2 Site 7

Alternatives GW2-1 and GW2-2 do not use active treatment of site contaminants; therefore, this criterion is not applicable.

Alternative GW2-3 uses pre-treatment at the site or treatment at the POTW to remove and ultimately destroy more than 0.36 pound of VOCs. The ultimate fate of the organics would depend on pre-treatment requirements. If pre-treatment is used, the organics would adsorb onto GAC. During off-site regeneration of the GAC, the organics would be thermally oxidized into mineral compounds. If the organics are treated in the POTW, they would be subject to biological degradation, volatilization (and photochemical destruction), and adsorption onto sludge for ultimate disposal in a landfill.

2.10.4.3 Sites 9 and 23

Alternatives GW3-1 and GW3-2 do not use active treatment of site contaminants; therefore, this criterion is not applicable.

2.10.5 Short-Term Effectiveness

2.10.5.1 Sites 3 and 7

Both groundwater alternatives are expected to be effective in the short term. The groundwater is currently classified as GB, and the contamination is sporadically distributed across Sites 3 and 7. Groundwater is not used for human consumption, and public potable water is available and used.

There would not be any short-term risks to the community, workers, or environment under Alternative GW1-1 because no active RA would be taken. Alternative GW1-2 remedial actions, including well installation and monitoring, along with implementation of institutional controls, would pose no short-term risk as long as proper worker safety precautions were made when handling potentially contaminated soil and groundwater during well installation and monitoring.

Alternative GW1-1 would not achieve the RAOs. Alternative GW1-2 would achieve the RAOs within approximately 6 months, the time required to implement institutional controls and start monitoring. Under both alternatives, final degradation of site groundwater contamination is expected to require years to decades to complete.

2.10.5.2 Site 7

All three groundwater alternatives are expected to be effective in the short term. The groundwater is currently classified as GB at Site 7. Groundwater is not used for human consumption, and public potable water is available and used.

There would not be any short-term risks to the community, workers, or environment under any of the three alternatives. Under Alternatives GW2-2 and GW2-3, no short-term risks would result as long as proper worker safety precautions were taken during implementation of the alternatives.

Alternative GW2-1 would not achieve the RAOs. Alternative GW2-2 would achieve the RAOs within approximately 6 months, the time required to implement institutional controls and start monitoring. Under both alternatives, final degradation of site groundwater contamination is expected to require years to decades to complete. Alternative GW2-3 can be completed within 1.5 years after the start of design activities. RAOs would be achieved at that time.

2.10.5.3 Sites 9 and 23

Both groundwater alternatives are expected to be effective in the short term. The groundwater is currently classified as GB, groundwater is not used for human consumption, and public potable water is available and used. There would not be any short-term risks to the community, workers, or environment under Alternative GW3-1 because no active RA would be taken. Implementation of institutional controls under Alternative GW3-2 would pose no short-term risk as long as proper worker safety precautions were taken when site inspections are performed.

2.10.6 Implementability

2.10.6.1 Sites 3 and 7

Alternatives GW1-1 and GW1-2 would be easy to implement. All the necessary documents for Alternatives GW1-2 (groundwater monitoring plan, institutional controls, etc.) can be handled internally by the Navy. Vendors and equipment to perform groundwater monitoring are common and readily available.

2.10.6.2 Site 7

Because no active RA is occurring, Alternatives GW2-1 and GW2-2 would be easy to implement. All the necessary documents for Alternatives GW2-2 (groundwater monitoring plan, institutional controls, etc.) can be handled internally by the Navy. Vendors and equipment to perform groundwater monitoring are common and readily available.

Alternative GW2-3 should be readily implementable. Vendors and equipment to perform this work are common and readily available. POTW facility capacity is also adequate.

2.10.6.3 Sites 9 and 23

Alternatives GW3-1 and GW3-2 would be easy to implement. All the necessary documents for Alternatives GW3-2 associated with institutional controls can be handled internally by the Navy.

2.10.7 Cost

The estimated costs for the alternatives are presented below. It should be noted that for the alternatives evaluated, capital costs and annual O&M costs were calculated using present dollars, and do not account for inflation or the future value of money when calculating annual costs.

Alternative	Capital Cost	O&M Cost (Present Worth)	Total Cost (Present Worth)
Sites 3 and 7			
Alternative GW1-1	$0	$89,600	$89,600
Alternative GW1-2	$59,200	$260,300	$319,500
Site 7			
Alternative GW2-1	$0	$89,600	$89,600
Alternative GW2-2	$59,700	$244,100	$303,800
Alternative GW2-3	$1,018,600	$105,500	$1,121,000
Sites 9 and 23			
Alternative GW3-1	$0	$89,600	$89,600
Alternative GW3-2	$10,295	$108,705	$119,000

2.10.8 State Acceptance

The State of Connecticut has expressed their support with the Selected Remedy (described in Section 2.12). The state's concurrence letter is provided in Appendix A.

2.10.9 *Community Acceptance*

Based on comments expressed at the Public Meeting on June 26, 2008 and the written comments received during the public comment period, it appears that the community generally agrees with the Selected Remedy presented in the Proposed Plan. Specific responses to issues raised by the community can be found in the Responsiveness Summary in Section 3.0 of this ROD.

2.11 PRINCIPAL THREAT WASTE

The NCP establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable [40 CFR 300.430(a)(1)(iii)(A)]. Based on the results of the investigations and studies, the contaminants in the groundwater at Sites 2, 3, 7, 9, 14, 15, 18, 20, and 23 do not constitute principal threat wastes as defined by the NCP.

2.12 SELECTED REMEDY

This section identifies the Selected Remedy and expands on the details provided in Section 2.9 (Description of Alternatives) of the ROD.

2.12.1 Sites 3 and 7

The Selected Remedy for Sites 3 and 7 groundwater is to combine Alternatives GW1-2 and GW2-2, Institutional Controls and Monitoring. The Selected Remedy was first documented in the 2004 Interim ROD and has not changed in this Final ROD. The Selected Remedy meets all of the RAOs by restricting access to and use of contaminated groundwater and by monitoring the decay and potential migration of contaminated groundwater at the sites. The Selected Remedy consists of three major components: (1) implementation and long-term monitoring of LUCs at the sites, (2) conducting a comprehensive monitoring program to track the degradation and decay of site contaminants until they reach RGs and the resulting concentrations are shown to be protective of human health and the environment, and to verify that groundwater contaminants are not migrating and impacting other resources, and (3) completion of five-year reviews of the site until the RGs are reached. The RGs for the Selected Remedy are provided in Tables 2-19 and 2-20. The components of the remedy are discussed in more detail below.

2.12.1.1 Institutional Controls

Based on the Interim ROD for groundwater at Sites 3, 7, 14, 15, 18, and 20 (Navy, 2004e), the Navy prepared a LUC Remedial Design (RD) to implement LUCs for Sites 3 and 7 groundwater (Navy, 2005). In accordance with this approved LUC RD, the Navy is responsible for implementing, inspecting, reporting on, and maintaining the institutional controls described in the ROD when the base is active through the NSB-NLON IR Site Use Restrictions document, and if the property is transferred to civilian ownership, through property transfer documents that include environmental land use restrictions. Should any institutional control component of the selected remedy fail, the Navy will ensure that appropriate actions are taken to re-establish the Selected Remedy's protectiveness. The Navy may transfer various operational responsibilities for these actions to other parties through contracts, agreements, and/or deed restrictions. However, the Navy acknowledges its ultimate liability under CERCLA for remedy integrity, including for the performance of any transferred operational responsibilities.

The groundwater institutional controls are required because there are hazardous substances in groundwater at Sites 3 and 7 at concentrations that could result in unacceptable risks if groundwater use was not controlled or restricted. The objectives of the institutional controls for the Selected Remedy are as follows:

- Prevent the withdrawal and/or use of groundwater from Sites 3 and 7 for potable water purposes or other purposes that may result in unacceptable risks to human health and the environment until the RGs identified in this ROD are met.

- Ensure that groundwater extracted from Sites 3 and 7 during groundwater monitoring or construction dewatering activities is handled, stored, and disposed in accordance with applicable state and federal regulatory requirements.

- Maintain the integrity of the proposed groundwater monitoring system for Sites 3 and 7 until the RGs identified in this ROD are met.

Figure 2-21 identifies the areas at NSB-NLON that have groundwater LUCs. The controls on groundwater use at Sites 3 and 7 will be maintained until the results of the groundwater monitoring program show that the concentrations of hazardous substances in groundwater are less than the RGs that allow for unrestricted use and unlimited exposure.

NSB-NLON Installation Restoration Site Use Restrictions Instruction document (5090.18B), dated February 5, 2003, was updated in accordance with the Interim ROD to include groundwater use restrictions at Sites 3 and 7. An updated document, SOPA (ADMIN) New London Instruction 5090.18C was issued on December 14, 2006. The current SOPA (ADMIN) New London Instruction 5090.18D is included in Appendix B. Other LUC implementation actions completed or to be completed are described in the LUC RD (Navy, 2005). Based on the results of the 2008 vapor intrusion evaluation, the institutional controls for Site 3 will be amended to state that additional evaluation or installation of mitigative measures relating to vapor intrusion will be implemented if future residential construction takes place within 100 feet of well 2DMW29S.

NSB-NLON is currently an active Navy base and is expected to remain so into the foreseeable future. Potential future land uses for Sites 3 and 7 while the Navy owns the property include the continued use of the sites under their current Naval functions (i.e., industrial and recreational). Future land uses are limited because portions of Sites 3 and 7 are located within designated ESQD arcs of Site 20. Navy regulations prohibit construction of inhabited buildings or structures within these arcs and, although existing buildings operate under a waiver of these regulations, no further construction or residential development is planned for these sites. In addition, the groundwater aquifers found within the overburden and bedrock at Sites 3 and 7 are classified as GB by the State of Connecticut. Based on the GB classification, the groundwater is presumed not suitable for human consumption without treatment. Neither aquifer is currently used as a source of drinking water or for industrial water supply purposes, and there are no plans to use either aquifer in the future for these purposes. The institutional controls for groundwater implemented for Sites 3 and 7 place further restrictions on the extraction and use of groundwater at these sites until the groundwater RGs are reached. In the event that the Navy sells or transfers the property in the future, and with confirmation that contaminated groundwater remains at Sites 3 and/or 7, an environmental land use restriction pursuant to state law would be needed to prohibit the use of groundwater at the sites during

subsequent site ownership. Future commercial or residential land use would be permitted as long as controls on groundwater extraction and use were maintained. In accordance with the Navy's responsibilities under CERCLA and the FFA, the administrative implementability of institutional controls would require including adequate provisions in any property transfer documents to ensure continuation of these controls should the Navy sell or transfer the property.

2.12.1.2 Monitoring

Groundwater monitoring has been conducted at Sites 3 and 7 since May 2006 in accordance with the Interim ROD and Sites 3 and 7 Groundwater Monitoring Plan (GMP) included in the O&M Manual For IR Program Sites (TtNUS, 2006a). After signing of the Interim ROD, a Work Plan for Remedial Action at Sites 3 and 7 (TtNUS, 2006b) was submitted describing the field activities required to complete the monitoring well network and the requirements for sampling and analysis. Prior to the start of monitoring, eight new wells were installed and developed, including three overburden wells at Site 3, one bedrock well at Site 3, and four overburden wells at Site 7, and the nine existing wells to be sampled as part of the monitoring program (five wells at Site 3 and four at Site 7) were redeveloped. Year 1 monitoring results for Sites 3 and 7 are presented in Tables 2-1 and 2-2, respectively.

The nine wells at Site 3 and seven of the eight wells at site 7 are analyzed for VOCs. Six wells at Site 7 are also analyzed for SVOCs, and one well at Site 7 is analyzed for PAHs only. The PAH data are used to evaluate the effectiveness of the Site 7 soil remediation; PAHs are not groundwater COCs at Site 7 and do not have associated groundwater RGs. The results are used to confirm that PAHs in the source area did not migrate and impact underlying groundwater.

The Interim ROD stated that monitoring would be conducted quarterly for the first year, annually for the next 4 years, and then every 5 years thereafter until contaminant concentrations have decreased to less than RGs for three consecutive sampling events and the resulting concentrations are shown to be protective of human health and the environment, or until the remedy is otherwise deemed protective or modified. However, based on the results of Year 1 sampling, continued quarterly sampling of Sites 3 and 7 for Year 2 was recommended (TtNUS, 2007). At the completion of the RA, the RGs will be met in groundwater at each of the monitoring wells included in the monitoring well network. A risk assessment following the most recent methodology may need to be completed to show that the resulting concentrations are protective of human health.

The COCs at Sites 3 and 7 are subject to natural degradation processes including biological, chemical, and physical processes. The magnitude and extent of this contamination are expected to decrease naturally overtime, and monitoring results will be used to track these decreases.

If subsurface activities are conducted and groundwater is to be encountered, construction workers must wear appropriate personnel protective equipment (PPE). If contaminated groundwater is to be removed, it must be tested, handled, and disposed properly (e.g., at a POTW or off-site treatment facility and not discharged to an adjacent stream without treatment).

2.12.1.3 Five-Year Reviews

Five-year reviews will be conducted for Sites 3 and 7 groundwater as required under CERCLA until the monitoring program shows that the RGs have been reached and the resulting concentrations are shown to be protective of human health and the environment. The goal of conducting the site reviews is to verify that no changes have occurred that would impact the effectiveness of the Selected Remedy.

2.12.2 Sites 9 and 23

The Selected Remedy for Sites 9 and 23 groundwater is Alternative GW3-2, Institutional Controls. The Selected Remedy meets all of the RAOs by restricting access to and use of contaminated groundwater and consists of two major components: (1) implementation of LUCs at the sites and (3) completion of five-year reviews. The components of the remedy are discussed in more detail below.

2.12.2.1 Institutional Controls

Implementation of institutional controls at Sites 9 and 23 involves identifying the location, magnitude, and type of contamination and documenting it in a LUC RD and in the NSB-NLON IR Site Use Restrictions document. These documents present the LUC objectives and include specific drawings and instructions for Navy personnel so that contaminated groundwater will not be extracted or used in a manner that would threaten human health or the environment. In accordance with the LUC RD to be prepared for Site 9 and 23, the Navy will be responsible for implementing, inspecting, reporting on, and maintaining the institutional controls described in the ROD. Should any institutional control component of the selected remedy fail, the Navy will ensure that appropriate actions are taken to re-establish the Selected Remedy's protectiveness. The Navy may transfer various operational responsibilities for these actions to other parties through contracts, agreements, and/or deed restrictions. However, the Navy acknowledges its ultimate liability under CERCLA for remedy integrity, including for the performance of any transferred operational responsibilities.

The groundwater institutional controls are required because there are hazardous substances in groundwater at Sites 9 and 23 at concentrations that could result in unacceptable risks if groundwater use was not controlled or restricted. The objectives of the institutional controls for the Selected Remedy are as follows:

- Prevent the withdrawal and/or use of groundwater from Sites 9 and 23 for potable water purposes or other purposes that may result in unacceptable risks to human health and the environment.

- Ensure that groundwater extracted from Sites 9 and 23 during construction dewatering activities is handled, stored, and disposed in accordance with applicable state and federal regulatory requirements.

Figure 2-21 identifies the areas at NSB-NLON that have groundwater LUCs. The controls on groundwater use at Sites 9 and 23 will be maintained until the concentrations of hazardous substances in groundwater are less than levels that allow for unrestricted use and unlimited exposure.

NSB-NLON Installation Restoration Site Use Restrictions Instruction document (5090.18D) (Appendix B) has been updated in accordance with this ROD to include groundwater use restrictions at Sites 9 and 23. Other LUC implementation actions completed or to be completed will be described in the LUC RD to be issued by the Navy.

NSB-NLON is currently an active Navy base and is expected to remain so into the foreseeable future. Potential future land uses for Sites 9 and 23 while the Navy owns the property include the continued use of the sites under their current Naval functions (i.e., industrial and recreational). The groundwater at Sites 9 and 23 are classified as GB by the State of Connecticut. Based on the GB classification, the groundwater is presumed not suitable for human consumption without treatment and is not currently used as a source of drinking water or for industrial water supply purposes, and there are no plans to use it in the future for these purposes. The institutional controls for groundwater implemented for Sites 9 and 23 place further restrictions on the extraction and use of groundwater at these sites. In the event that the Navy sells or transfers the property in the future, and with confirmation that contaminated groundwater remains at Sites 9 and/or 23, an environmental land use restriction pursuant to state law would be needed to prohibit the use of groundwater at the sites during subsequent site ownership. Future commercial or residential land use would be permitted as long as controls on groundwater extraction and use were maintained.

2.12.2.2 Five-Year Reviews

Five-year reviews will be conducted for Sites 9 and 23 groundwater as required under CERCLA until contaminant concentrations are shown to be protective of human health and the environment. The goal of conducting the site reviews is to verify that no changes have occurred that would impact the effectiveness of the Selected Remedy.

2.12.3 Sites 2A, 2B, 14, 15, 18, and 20

This ROD selects NFA for groundwater at Sites 14, 15, 18, and 20. Available information indicates that groundwater at these sites does not pose any unacceptable risks to human health or the environment. Groundwater monitoring at Sites 2A and 2B will continue as required by the OU1 ROD and the O&M Manual for IR Program Sites (TtNUS, 2006a). This ROD proposes no change to the OU1 ROD.

2.13 STATUTORY DETERMINATIONS

Under CERCLA Section 121 and the NCP, the lead agency (i.e., Navy) must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practical. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of contamination as a principal element and a bias against off-site disposal of untreated wastes.

The following sections discuss how the Selected Remedy for Sites 3 and 7 and Sites 9 and 23 groundwater meet these statutory requirements. Because NFA was selected for groundwater at Sites 14, 15, 18, and 20, an evaluation of statutory requirements for these sites is not necessary.

2.13.1 Protection of Human Health and the Environment

2.13.1.1 Sites 3 and 7

The Selected Remedy for groundwater at Sites 3 and 7 (Institutional Controls with Monitoring, Alternatives GW1-2 and GW2-2) addresses potential future risks and provides adequate protection of human health and the environment. Potential future risks are addressed by restricting future residential use (RAOs A-1 and B-1), providing requirements for groundwater that could be extracted and discharged during construction activities (e.g., excavation dewatering), and monitoring the migration and natural degradation of groundwater contaminants (RAOs A-3 and B-3). Based on existing data and evaluations, groundwater is not anticipated to represent a significant risk to current receptors (construction workers) through incidental contact (RAOs A-2 and B-2) or to ecological receptors through migration (RAOs A-3 and B-3).

2.13.1.2 Sites 9 and 23

The Selected Remedy for groundwater at Sites 9 and 23 (Institutional Controls, Alternative GW3-2) addresses potential future risks and provides adequate protection of human health and the environment.

Potential future risks are addressed by restricting future residential use (RAO C-1) and providing requirements for groundwater that could be extracted and discharged during construction activities (e.g., excavation dewatering). Based on existing data and evaluations, groundwater is not anticipated to represent a significant risk to current receptors (construction workers) through incidental contact or to ecological receptors through migration (RAO C-2).

2.13.2 Compliance with ARARs

2.13.2.1 Sites 3 and 7

An assessment of ARARs and TBCs for the Sites 3 and 7 Selected Remedy is provided in Tables 2-22, 2-23, and 2-24. The remedy will comply with all chemical-specific ARARs and TBCs. Chemical-specific ARARs include the RSRs; these Connecticut regulations provide specific numerical cleanup criteria for contaminants in groundwater. Requirements are based on groundwater in the area being classified by the state as GB. Institutional controls or environmental land use restrictions pursuant to state law (if the Navy sells the property in the future) will be implemented to prevent contact with and use of contaminated groundwater. Even though contaminants in site groundwater currently exceed groundwater quality standards (Class GA), site groundwater is classified as GB. GA groundwater quality should ultimately be obtained through natural degradation. Monitoring would be used to track these decreases until concentrations are less than acceptable levels. The remedy would meet chemical-specific TBCs by preventing exposure to contaminated groundwater until concentrations are less than acceptable levels that meet human health concerns.

The Selected Remedy also complies with all action-specific ARARs. Monitoring would continue until concentrations are less than acceptable levels that meet human health concerns. Any waste (soil or groundwater) generated monitoring activities will be properly characterized and disposed. Location-specific ARARs are not applicable to the Selected Remedy.

2.13.2.2 Sites 9 and 23

An assessment of ARARs and TBCs for the Sites 9 and 23 Selected Remedy is provided in Tables 2-28 and 2-29. The remedy will comply with all chemical-specific ARARs and TBCs. Chemical-specific ARARs include the RSRs; these Connecticut regulations provide specific numerical cleanup criteria for contaminants in groundwater. Requirements are based on groundwater in the area being classified by the state as GB. Institutional controls or environmental land use restrictions (if the Navy sells the property in the future) will be implemented to prevent contact with and use of contaminated groundwater. Even though contaminants in site groundwater currently exceed groundwater quality standards (Class GA), site groundwater is classified as GB. The remedy would meet chemical-specific TBCs by preventing

exposure to contaminated groundwater until concentrations are less than acceptable levels that meet human health concerns.

The Selected Remedy also complies with all action-specific ARARs. Monitoring would continue until concentrations are less than acceptable levels that meet human health concerns. Location-specific ARARs are not applicable to the Selected Remedy.

2.13.3 Cost Effectiveness

2.13.3.1 Sites 3 and 7

The Selected Remedy for Sites 3 and 7 is considered to be the most cost-effective alternative. The lower cost No Action alternatives (GW1-1 and 2-1) would not satisfy the threshold criteria or RAOs, and Extraction and Off-Site Discharge (Alternative GW2-3) would cost over $1 million and only address Site 7 groundwater contaminants.

The cost for the Selected Remedy is estimated to be the sum of the costs for Alternatives GW1-2 ($319,500) and GW2-2 ($303,800), or $623,300. Although some economy may be realized when combining the alternatives, any savings are expected to be within the accuracy range of an FS level cost estimate (e.g., -30 to +50 percent); therefore, no attempt was made to further refine this cost. The present worth cost analysis for the Selected Remedy is presented in Appendix G and summarized as follows:

- Estimated Time for Design and Construction: 6 months
- Estimated Time for Operation: 30 years
- Estimated Capital Cost: $118,900
- Estimated O&M Costs (Present Worth): $504,400
- Estimated Total Present Worth: $623,300

2.13.3.2 Sites 9 and 23

The Selected Remedy for Sites 9 and 23 is considered to be the most cost-effective alternative. The lower cost No Action alternative (GW3-1) would not satisfy the threshold criteria or RAOs. The present worth cost analysis for the Selected Remedy is presented in Appendix G and summarized as follows:

- Estimated Time for Design and Construction: 6 months
- Estimated Time for Operation: 30 years
- Estimated Capital Cost: $10,295

- Estimated O&M Costs (Present Worth): $108,705
- Estimated Total Present Worth: $119,000

2.13.4 Utilization of Permanent Solutions and Alternative Treatment

The Navy, with EPA and state concurrence, has determined that the Selected Remedies represent the maximum extent to which permanent solutions and treatment technologies can be utilized in a practical manner for the groundwater at Sites 3 and 7 and Sites 9 and 23. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Navy has determined that the Selected Remedies provide the best balance of trade-offs in terms of the five balancing criteria.

The Navy also considered the statutory preference for treatment as a principal element, the bias against off-site treatment and disposal, and EPA, state, and community acceptance. In-situ and above-ground treatment technologies for groundwater were screened for Sites 3 and 7 in the technology screening section of the FSs, but based on concerns about effectiveness because of relatively low contaminant concentrations and the sporadic distribution of contamination, coupled with anticipated high costs, these technologies were not retained for development of alternatives. Active remedial technologies were not evaluated for Sites 9 and 23 because of the absence of a contaminant plume and other sites conditions including generally low concentrations of contaminants, groundwater not classified as a suitable potable water source, and availability and use of a public water supply.

2.13.5 Preference for Treatment as a Principal Element

The Selected Remedies do not satisfy the statutory preference for treatment as a principal element. The reasons why treatment of Sites 3 and 7 and Sites 9 and 23 groundwater is not practical are discussed in Section 2.13.4.

2.13.6 Five-Year Review Requirements

Because the Selected Remedy for groundwater at Sites 3 and 7 will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of the RA for Sites 3 and 7 groundwater, every 5 years until RGs are met, to ensure that the remedy is, or will be, protective of human health and the environment. Also, because the Selected Remedy for groundwater at Sites 9 and 23 will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of the RA and every 5 years thereafter to ensure that the remedy is, or will be, protective of human health and the environment. Five-year reviews are not required under

OU9 for Sites 14, 15, 18, or 20 because hazardous substances, pollutants, or contaminants are not present on site in excess of levels that allow for unlimited use and unrestricted exposure. Five-year reviews of the OU1 remedy will continue for Sites 2A and 2B based on the OU1 ROD (Navy, 1995).

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23 groundwater at NSB-NLON, Groton, Connecticut was released for public comment on June 14, 2008. The Proposed Plan identified Institutional Controls with Monitoring (Alternatives GW1-2 and GW2-2) as the Selected Remedy for Sites 3 and 7 groundwater and Institutional Controls (Alternative GW3-2) as the Selected Remedy for Sites 9 and 23 groundwater. NFA was recommended for Sites 14, 15, 18, and 20 groundwater in the Proposed Plan. Available information indicates that the groundwater at Sites 2, 14, 15, 18, and 20 do not pose any significant risks to human health or the environment. Groundwater monitoring and institutional controls will continue at Sites 2A and 2B as part of the OU1 remedy.

The Navy reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to these decisions, as originally identified in the Proposed Plan, were necessary or appropriate.

TABLE 2-1

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 3
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT
PAGE 1 OF 3

CHEMICAL OF CONCERN	REMEDIAL GOAL	2DMW16D			
		May-06	Oct-06	Jan-07	Mar-07
VOLATILE ORGANIC COMPOUNDS (µg/L)					
TRICHLOROETHENE	5	5.7	7	7	7
VINYL CHLORIDE	2	0.5 U	1 U	1 U	1 U

CHEMICAL OF CONCERN	REMEDIAL GOAL	2DMW16S				
					Mar-07	
		May-06	Oct-06	Jan-07	Sample	Duplicate
VOLATILE ORGANIC COMPOUNDS (µg/L)						
TRICHLOROETHENE	5	0.5 U	1 U	1 U	1 U	1 U
VINYL CHLORIDE	2	0.5 U	1 U	1 U	1 U	1 U

CHEMICAL OF CONCERN	REMEDIAL GOAL	2DMW25S					
		May-06		Oct-06	Jan-07		Mar-07
		Sample	Duplicate		Sample	Duplicate	
VOLATILE ORGANIC COMPOUNDS (µg/L)							
TRICHLOROETHENE	5	0.5 U	0.5 U	1 U	1 U	1 U	1 U
VINYL CHLORIDE	2	0.5 U	0.5 U	1 U	1 U	1 U	1 U

CHEMICAL OF CONCERN	REMEDIAL GOAL	2DMW28D			
		May-06	Oct-06	Jan-07	Mar-07
VOLATILE ORGANIC COMPOUNDS (µg/L)					
TRICHLOROETHENE	5	0.5 U	1 U	1 U	1 U
VINYL CHLORIDE	2	0.5 U	1 U	1 U	1 U

TABLE 2-1

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 3
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

CHEMICAL OF CONCERN	REMEDIAL GOAL	2DMW29S				
		May-06	Oct-06		Jan-07	Mar-07
			Sample	Duplicate		
VOLATILE ORGANIC COMPOUNDS (µg/L)						
TRICHLOROETHENE	5	0.5 U	1 U	1 U	1 U	1 U
VINYL CHLORIDE	2	1.7	9	10	1 U	4

CHEMICAL OF CONCERN	REMEDIAL GOAL	3MW15I			
		May-06	Oct-06	Jan-07	Mar-07
VOLATILE ORGANIC COMPOUNDS (µg/L)					
TRICHLOROETHENE	5	0.5 U	1 U	1 U	1 U
VINYL CHLORIDE	2	0.5 U	1 U	1 U	1 U

CHEMICAL OF CONCERN	REMEDIAL GOAL	3MW15S				
		May-06		Oct-06	Jan-07	Mar-07
		Sample	Duplicate			
VOLATILE ORGANIC COMPOUNDS (µg/L)						
TRICHLOROETHENE	5	0.5 U	0.5 U	1 U	1 U	1 U
VINYL CHLORIDE	2	0.5 U	0.5 U	1 U	1 U	1 U

CHEMICAL OF CONCERN	REMEDIAL GOAL	3MW16D			
		May-06	Oct-06	Jan-07	Mar-07
VOLATILE ORGANIC COMPOUNDS (µg/L)					
TRICHLOROETHENE	5	5.1	2	2	4
VINYL CHLORIDE	2	0.5 U	1 U	1 U	1 U

TABLE 2-1

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 3
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

CHEMICAL OF CONCERN	REMEDIAL GOAL	3MW16S			
		May-06	Oct-06	Jan-07	Mar-07
VOLATILE ORGANIC COMPOUNDS (µg/L)					
TRICHLOROETHENE	5	0.5 U	1 U	1 U	1 U
VINYL CHLORIDE	2	0.5 U	1 U	1 U	1 U

Shaded cell indicates exceedance of the remedial goal.
U - Not detected at associated detection limit.
J - Estimated concentration.

TABLE 2-2

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 7
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

CHEMICAL OF CONCERN	REMEDIAL GOAL	7MW01D				
		May-06	Oct-06		Jan-07	Mar-07
			Sample	Duplicate		
VOLATILE ORGANIC COMPOUNDS (µg/L)						
1,4-DICHLOROBENZENE	75 (1)	0.5 U	1 U	1 U	1 U	1 U
BENZENE	1 (1)	0.5 U	1 U	1 U	1 U	1 U
CHLOROBENZENE	100 (1)	0.5 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	5 (1)	0.5 U	1 U	1 U	1 U	1 U
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)						
HEXACHLOROBENZENE	1 (1)	-	-	-	-	-
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/L)						
BENZO(A)ANTHRACENE	0.3 (2)	-	-	-	-	-
BENZO(A)PYRENE	0.3 (2)	-	-	-	-	-
BENZO(B)FLUORANTHENE	0.3 (2)	-	-	-	-	-
INDENO(1,2,3-CD)PYRENE	NC (2)	-	-	-	-	-

TABLE 2-2

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 7
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

CHEMICAL OF CONCERN	REMEDIAL GOAL	7MW03I				
					Mar-07	
		May-06	Oct-06	Jan-07	Sample	Duplicate
VOLATILE ORGANIC COMPOUNDS (µg/L)						
1,4-DICHLOROBENZENE	75 (1)	0.5 U	1 U	1 U	1 U	1 U
BENZENE	1 (1)	0.5 U	1 U	1 U	1 U	1 U
CHLOROBENZENE	100 (1)	0.5 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	5 (1)	0.5 U	1 U	1 U	1 U	1 U
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)						
HEXACHLOROBENZENE	1 (1)	1 U	1 U	0.2 U	0.2 U	-
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/L)						
BENZO(A)ANTHRACENE	0.3 (2)	-	-	-	-	-
BENZO(A)PYRENE	0.3 (2)	-	-	-	-	-
BENZO(B)FLUORANTHENE	0.3 (2)	-	-	-	-	-
INDENO(1,2,3-CD)PYRENE	NC (2)	-	-	-	-	-

TABLE 2-2

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 7
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

CHEMICAL OF CONCERN	REMEDIAL GOAL	7MW03S				
		May-06	Oct-06	Jan-07 Sample	Jan-07 Duplicate	Mar-07
VOLATILE ORGANIC COMPOUNDS (µg/L)						
1,4-DICHLOROBENZENE	75 (1)	0.5 U	1 U	1 U	1 U	1 U
BENZENE	1 (1)	0.5 U	1 U	1 U	1 U	1 U
CHLOROBENZENE	100 (1)	0.5 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	5 (1)	0.5 U	1 U	1 U	1 U	1 U
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)						
HEXACHLOROBENZENE	1 (1)	1 U	1 U	0.2 U	0.2 U	0.2 U
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/L)						
BENZO(A)ANTHRACENE	0.3 (2)	-	-	-	-	-
BENZO(A)PYRENE	0.3 (2)	-	-	-	-	-
BENZO(B)FLUORANTHENE	0.3 (2)	-	-	-	-	-
INDENO(1,2,3-CD)PYRENE	NC (2)	-	-	-	-	-

TABLE 2-2

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 7
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

CHEMICAL OF CONCERN	REMEDIAL GOAL	7MW05D			
		May-06	Oct-06	Jan-07	Mar-07
VOLATILE ORGANIC COMPOUNDS (µg/L)					
1,4-DICHLOROBENZENE	75 (1)	0.5 U	1 U	1 U	1 U
BENZENE	1 (1)	0.5 U	1 U	1 U	1 U
CHLOROBENZENE	100 (1)	0.5 U	1 U	1 U	1 U
TRICHLOROETHENE	5 (1)	0.72	1	1	0.9 J
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)					
HEXACHLOROBENZENE	1 (1)	-	-	-	-
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/L)					
BENZO(A)ANTHRACENE	0.3 (2)	-	-	-	-
BENZO(A)PYRENE	0.3 (2)	-	-	-	-
BENZO(B)FLUORANTHENE	0.3 (2)	-	-	-	-
INDENO(1,2,3-CD)PYRENE	NC (2)	-	-	-	-

TABLE 2-2

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 7
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

CHEMICAL OF CONCERN	REMEDIAL GOAL	7MW09S			
		May-06	Oct-06	Jan-07	Mar-07
VOLATILE ORGANIC COMPOUNDS (µg/L)					
1,4-DICHLOROBENZENE	75 (1)	0.5 U	1 U	1 U	1 U
BENZENE	1 (1)	0.5 U	1 U	1 U	1 U
CHLOROBENZENE	100 (1)	0.5 U	1 U	1 U	1 U
TRICHLOROETHENE	5 (1)	0.5 U	1 U	1 U	1 U
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)					
HEXACHLOROBENZENE	1 (1)	1 U	0.14 J	0.2 U	0.20 U
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/L)					
BENZO(A)ANTHRACENE	0.3 (2)	-	-	-	-
BENZO(A)PYRENE	0.3 (2)	-	-	-	-
BENZO(B)FLUORANTHENE	0.3 (2)	-	-	-	-
INDENO(1,2,3-CD)PYRENE	NC (2)	-	-	-	-

TABLE 2-2

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 7
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

CHEMICAL OF CONCERN	REMEDIAL GOAL	7MW12I			
		May-06	Oct-06	Jan-07	Mar-07
VOLATILE ORGANIC COMPOUNDS (µg/L)					
1,4-DICHLOROBENZENE	75 (1)	0.5 U	1 U	1 U	1 U
BENZENE	1 (1)	0.5 U	1 U	1 U	1 U
CHLOROBENZENE	100 (1)	0.5 U	1 U	1 U	1 U
TRICHLOROETHENE	5 (1)	0.86	0.9 J	1	0.7 J
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)					
HEXACHLOROBENZENE	1 (1)	1 U	1 U	0.2 U	0.2 U
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/L)					
BENZO(A)ANTHRACENE	0.3 (2)	-	-	-	-
BENZO(A)PYRENE	0.3 (2)	-	-	-	-
BENZO(B)FLUORANTHENE	0.3 (2)	-	-	-	-
INDENO(1,2,3-CD)PYRENE	NC (2)	-	-	-	-

TABLE 2-2

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 7
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

CHEMICAL OF CONCERN	REMEDIAL GOAL	7MW12S			
		May-06	Oct-06	Jan-07	Mar-07
VOLATILE ORGANIC COMPOUNDS (µg/L)					
1,4-DICHLOROBENZENE	75 (1)	0.5 U	1 U	1 U	1 U
BENZENE	1 (1)	0.5 U	1 U	1 U	1 U
CHLOROBENZENE	100 (1)	1.3	1 J	2	2
TRICHLOROETHENE	5 (1)	0.5 U	1 U	1 U	1 U
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)					
HEXACHLOROBENZENE	1 (1)	1 U	1 U	0.2 U	0.2 U
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/L)					
BENZO(A)ANTHRACENE	0.3 (2)	-	-	-	-
BENZO(A)PYRENE	0.3 (2)	-	-	-	-
BENZO(B)FLUORANTHENE	0.3 (2)	-	-	-	-
INDENO(1,2,3-CD)PYRENE	NC (2)	-	-	-	-

TABLE 2-2

YEAR 1 GROUNDWATER MONITORING RESULTS FOR SITE 7
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

CHEMICAL OF CONCERN	REMEDIAL GOAL	7MW13S						
		May-06		Oct-06		Jan-07	Mar-07	
		Sample	Duplicate	Sample	Duplicate		Sample	Duplicate
VOLATILE ORGANIC COMPOUNDS (µg/L)								
1,4-DICHLOROBENZENE	75 (1)	-	-	-	-	-	-	-
BENZENE	1 (1)	-	-	-	-	-	-	-
CHLOROBENZENE	100 (1)	-	-	-	-	-	-	-
TRICHLOROETHENE	5 (1)	-	-	-	-	-	-	-
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)								
HEXACHLOROBENZENE	1 (1)	1 U	1 U	1 U	1 U	0.2 U	0.21 U	0.22 U
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/L)								
BENZO(A)ANTHRACENE	0.3 (2)	0.05 U	0.05 U	0.07 UJ	0.27 J	0.07 U	0.074 U	0.075 U
BENZO(A)PYRENE	0.3 (2)	0.05 U	0.05 U	0.05 U	0.05 U	0.2 U	0.21 U	0.22 U
BENZO(B)FLUORANTHENE	0.3 (2)	0.05 U	0.05 U	0.08 U	0.08 U	0.08 U	0.18 J	0.086 U
INDENO(1,2,3-CD)PYRENE	NC (2)	0.05 U	0.05 U	0.10 U	0.10 U	0.2 U	0.21 U	0.22 U

1 Remedial goal selected in Interim ROD (Navy, 2004c).
2 Monitoring criterion for protection of GB-classified groundwater.
Shaded cell indicates exceedance of the remedial goal.
U - Not detected at associated detection limit.
J - Estimated concentration.
(-) - Parameter not analyzed.

TABLE 2-3

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS FOR SITE 15
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

PARAMETER	15MW1S	15MW2S		15MW3S	15TW01	15TW02	15TW03
		Sample	Duplicate				
Volatile Organic Compounds (µg/L)							
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U	3
Unfiltered Inorganics (µg/L)							
ALUMINUM	37.4 U	2780	2820	58.7 U	2240 J	78.8 U	137 U
BARIUM	85.1	50.8	52.7	31.4	50.2	78.2	47.7
BERYLLIUM	0.37 U	1.1 U	1.1 U	0.37 U	0.84	0.37 U	0.37 U
CADMIUM	4.5 U	5.0 U	4.7 U	2.5 U	2.5 U	4.4	2.5 U
CALCIUM	26400	11900	12100	18800	8290	16000	34200
CHROMIUM	0.87 J	0.55 U	0.55 U	0.55 U	1.1 U	0.55 U	0.60 U
COBALT	5.1 U	8.4 J	7.8 J	5.1 U	9.5	5.1 U	7.3
COPPER	3.4 U	19.2	21.3	3.4 U	13.9	3.4 U	3.4 U
IRON	24.5 U	32.7 U	36.8 U	7800	427	80.4 U	215
LEAD	1.3 U	1.3 U	1.3 U	1.3 U	2.3	1.3 U	1.8
MAGNESIUM	2980	2000	2050	3780	1210	2200	3080
MANGANESE	4.8	223	227	287	340	41.1	702
POTASSIUM	4630	1540	1600	4390	1780	2120	5700
SODIUM	36200	35400	36200	42600	22600	45400	38300
ZINC	2.9 J	356	365	1.6 U	181	60.9	2.8 U
Filtered Inorganics (µg/L)							
ALUMINUM	25.4 U	35.4 U	2770 J	25.4 U	2160	66.1 U	25.4 U
BARIUM	83.6	12.5	52.2	34.6	50.7	77.5	47.8
BERYLLIUM	0.37 U	0.37 U	1.2 U	0.37 U	0.84	0.37 U	0.37 U
CADMIUM	3.2 U	2.7 U	6.3 U	2.5 U	2.5 U	6.4	2.5 U
CALCIUM	25800	5490	12000	19800	8350	16000	34700
CHROMIUM	0.75 J	0.55 U	0.55 U	0.56 J	0.80 U	0.55 U	0.55 U
COBALT	5.1 U	5.1 U	6.8 J	5.1 U	7.5	5.1 U	5.1 U
COPPER	3.4 U	3.4 U	18.2	3.4 U	15.2	3.4 U	3.4 U
IRON	12.0 U	2030 J	6.6 U	6740 J	366	75.7 U	135
LEAD	1.3 U	1.3 U	1.3 J	1.3 U	1.3 U	1.3 U	1.4
MAGNESIUM	2930	1120	2020	3870	1200	2180	3080
MANGANESE	4.2 J	311 J	226 J	279 J	350	40.1	703
POTASSIUM	4570	1420	1880	4900	1760	2050	5550
SODIUM	35500 J	14600 J	35400 J	43600 J	23200	44900	38100
ZINC	3.2 J	50.5 J	362 J	1.6 U	179	60.4	2.3 U

From Basewide Groundwater Operable Unit Remedial Investigation Update/Feasibility Study (TtNUS, 2004).

TABLE 2-4

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS FOR SITE 18
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

PARAMETER	18TW2		18TW4
	Sample	Duplicate	
Inorganics (µg/L)			
ALUMINUM	189 U	211 U	880
BERYLLIUM	0.6 U	0.6 U	0.79 J
CALCIUM	25000	25200	9640
IRON	306	328	1030
MAGNESIUM	1590 U	1650 U	2630
MANGANESE	111	111	322
POTASSIUM	1660 U	1670 U	2570
SODIUM	9570	9900	15100
Miscellaneous Parameters (mg/L)			
TOTAL DISSOLVED SOLIDS	146	174	111
TOTAL SUSPENDED SOLIDS	5 U	5 U	39

From Basewide Groundwater Operable Unit Remedial Investigation Report (TtNUS, 2002).
U - Not detected at associated detection limit.
J - Estimated concentration.

TABLE 2-5

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS FOR SITE 20
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARIINE BASE NEW LONDON
GROTON, CONNECTICUT

PARAMETER	2WCMW1S	2WCMW2S
Unfiltered Inorganics (µg/L)		
ALUMINUM	180 U	257
ARSENIC	3.2 J	2.0 U
BARIUM	81.4	14.4
CALCIUM	166000	5410
CHROMIUM	3.4	0.61 J
COPPER	3.4 U	3.6 J
IRON	50900	2970
LEAD	1.3 U	2.3 J
MAGNESIUM	41200	1210
MANGANESE	2350	216
POTASSIUM	44000	1390
SODIUM	353000	15200
ZINC	4.1	58.0
Filtered Inorganics (µg/L)		
ALUMINUM	41.0 U	2760 J
ARSENIC	3.4 J	2.0 U
BARIUM	85.2	52.0
CALCIUM	191000	12000
CHROMIUM	2.1	0.55 U
COBALT	5.1 U	9.3 J
COPPER	3.4 U	18.9
IRON	38000 J	7.7 U
MAGNESIUM	33500	2010
MANGANESE	2220 J	225 J
POTASSIUM	29100	1840
SODIUM	190000 J	35200 J
ZINC	2.3 J	361 J

From Basewide Groundwater Operable Unit Remedial Investigation Update/ Feasibility Study Report (TtNUS, 2004).
U - Not detected at associated detection limit.
J - Estimated concentration.

TABLE 2-6

SUMMARY OF DATA FROM 2007 UNDERDRAIN METERING PIT QUARTERLY SAMPLING EVENTS AT SITE 23
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT
PAGE 1 OF 3

PARAMETER	CTDEP Criteria		Stormwater Discharge Permit Criterion	23MP01					
	Surface Water Protection	Residential Volatilization		Jun-07		Sep-07	Dec-07		Feb-08
				Sample	Duplicate		Sample	Duplicate	
Volatile Organics (µg/L)									
BENZENE	710	130	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 J
BROMODICHLOROMETHANE	2.3	NE	NA	0.3 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROFORM	14,100	26	NA	3 J	2 J	0.5 U	0.5 U	0.5 U	0.5 U
CYCLOHEXANE	NE	NE	NA	0.5 U	0.5 U	0.1 J	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	NE	830	NA	0.3 J	0.2 J	0.3 J	0.2 J	0.5 U	0.2 J
ISOPROPYLBENZENE	NE	2,800	NA	0.1 J	0.09 J	0.1 J	0.5 U	0.5 UJ	0.5 U
METHYL TERT-BUTYL ETHER	NE	21,000	NA	1	0.9	0.4 J	0.6	0.6	0.7
TETRACHLOROETHENE	88	340	NA	0.3 J	0.3 J	0.4 J	0.3 J	0.2 J	0.3 J
TRICHLOROETHENE	2,340	27	NA	0.4 J	0.3 J	0.5 J	0.4 J	0.3 J	0.4 J
Semivolatile Organics (µg/L)									
1-METHYLNAPHTHALENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	0.96 J	0.048 J	0.21 U
2-METHYLNAPHTHALENE	NE	NE	NA	0.17 J	0.16 J	0.2 U	1.1 J	0.2 UJ	0.21 UJ
4-NITROANILINE	NE	NE	NA	0.2 U	0.2 U	1 UJ	0.75 J	1.0 UR	1.0 UJ
ACENAPHTHENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	0.83 J	0.029 J	0.21 U
ACENAPHTHYLENE	0.3	NE	NA	0.2 U	0.2 U	0.2 U	0.90 J	0.20 UJ	0.21 U
ANTHRACENE	1,100,000	NE	NA	0.2 U	0.2 U	0.2 U	0.92 J	0.20 UJ	0.21 U
BENZO(A)ANTHRACENE	0.3	NE	NA	0.07 U	0.07 U	0.041 U	1.0 J	0.042 UJ	0.045 U
BENZO(A)PYRENE	0.3	NE	NA	0.2 UJ	0.2 U	0.2 U	0.35 J	0.20 U	0.21 U
BENZO(B)FLUORANTHENE	0.3	NE	NA	0.08 U	0.08 U	0.075 U	0.64 J	0.078 UJ	0.082 U
BENZO(G,H,I)PERYLENE	NE	NE	NA	0.2 UJ	0.2 U	0.2 U	0.31	0.20 U	0.21 U
BENZO(K)FLUORANTHENE	0.3	NE	NA	0.2 UJ	0.2 UJ	0.2 U	0.53 J	0.20 U	0.21 U
CHRYSENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	0.76 J	0.20 UJ	0.21 U
DIBENZO(A,H)ANTHRACENE	NE	NE	NA	0.2 UJ	0.2 U	0.2 U	0.14 J	0.20 U	0.21 U
FLUORANTHENE	3,700	NE	NA	0.2 U	0.2 U	0.2 U	1.1 J	0.20 UJ	0.21 U
FLUORENE	140,000	NE	NA	0.2 U	0.2 U	0.2 U	0.97 J	0.20 UJ	0.21 UJ
HEXACHLOROBENZENE	0.077	NE	NA	1 U	1 U	0.2 U	1.2 J	0.20 UJ	0.21 U
HEXACHLOROBUTADIENE	NE	NE	NA	0.2 U	0.2 U	0.48 U	0.64 J	0.099 U	0.21 U
INDENO(1,2,3-CD)PYRENE	NE	NE	NA	0.2 UJ	0.2 U	0.2 U	0.22	0.20 U	0.21 UJ
NAPHTHALENE	NE	NE	NA	0.2 U	0.2 U	0.2 U	1.0 J	0.088 J	0.21 U
PHENANTHRENE	0.3	NE	NA	0.2 U	0.2 U	0.2 U	0.98 J	0.20 UJ	0.21 U
PYRENE	110,000	NE	NA	0.2 U	0.2 U	0.2 U	0.84 J	0.20 UJ	0.21 U

TABLE 2-6

SUMMARY OF DATA FROM 2007 UNDERDRAIN METERING PIT QUARTERLY SAMPLING EVENTS AT SITE 23
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

PARAMETER	CTDEP Criteria		Stormwater Discharge Permit Criterion	23MP01					
	Surface Water Protection	Residential Volatilization		Jun-07		Sep-07	Dec-07		Feb-08
				Sample	Duplicate		Sample	Duplicate	
Semivolatile Organics , Filtered (µg/L)									
1-METHYLNAPHTHALENE	NE	NE	NA	NA	NA	NA	NA	NA	0.093 J
2-METHYLNAPHTHALENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 UJ
4-NITROANILINE	NE	NE	NA	NA	NA	NA	NA	NA	1.0 UJ
ACENAPHTHENE	NE	NE	NA	NA	NA	NA	NA	NA	0.031 J
ACENAPHTHYLENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
ANTHRACENE	1,100,000	NE	NA	NA	NA	NA	NA	NA	02. U
BENZO(A)ANTHRACENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.042 U
BENZO(A)PYRENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
BENZO(B)FLUORANTHENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.078 U
BENZO(G,H,I)PERYLENE	NE	NE	NA	NA	NA	NA	NA	NA	0.13 J
BENZO(K)FLUORANTHENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
CHRYSENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 U
DIBENZO(A,H)ANTHRACENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 UJ
FLUORANTHENE	3,700	NE	NA	NA	NA	NA	NA	NA	0.2 U
FLUORENE	140,000	NE	NA	NA	NA	NA	NA	NA	0.2 UJ
HEXACHLOROBENZENE	0.077	NE	NA	NA	NA	NA	NA	NA	0.2 U
HEXACHLOROBUTADIENE	NE	NE	NA	NA	NA	NA	NA	NA	0.2 U
INDENO(1,2,3-CD)PYRENE	NE	NE	NA	NA	NA	NA	NA	NA	0.22 J
NAPHTHALENE	NE	NE	NA	NA	NA	NA	NA	NA	0.069 J
PHENANTHRENE	0.3	NE	NA	NA	NA	NA	NA	NA	0.2 U
PYRENE	110,000	NE	NA	NA	NA	NA	NA	NA	0.2 U
Inorganics, Total (µg/L)									
ALUMINUM	NE	NA	NA	473	115	322	38.1	21.8	29.4
ARSENIC	4	NA	NA	3.7 U	3 U	13.9	2.2 U	4.7 U	3.1
BARIUM	NE	NA	NA	48.2	52.4	87	55.2	53.4	55.9
CALCIUM	NUT	NA	NA	33,800	35,800	32,000	35,500	34,700	34,300
CHROMIUM	110 [2]	NA	NA	0.94 U	0.81 U	2	0.41	0.28 U	0.38 U
COBALT	NE	NA	NA	0.84 U	0.64 U	0.26 U	0.66	0.53	0.8 U
COPPER	48	NA	60	3 U	3 U	4.2	0.44 U	0.22 U	0.8 U
IRON	NUT	NA	NA	9,190	11,900	70,800	9,860	10,200	4,380
LEAD	13	NA	30	2.2	9.3	8.4	2.5 U	2.2 U	1.4 U
MAGNESIUM	NUT	NA	NA	7,260	7,660	7,020	7,660	7,490	7,450
MANGANESE	NE	NA	NA	661	715	845	858	815	784
NICKEL	880	NA	NA	1.1 U	0.88 U	0.41 U	0.53	0.46	0.64
POTASSIUM	NUT	NA	NA	5,210	5,490	5,270	5,590	5,490	5,150

TABLE 2-6

SUMMARY OF DATA FROM 2007 UNDERDRAIN METERING PIT QUARTERLY SAMPLING EVENTS AT SITE 23
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

PARAMETER	CTDEP Criteria		Stormwater Discharge Permit Criterion	23MP01					
	Surface Water Protection	Residential Volatilization		Jun-07		Sep-07	Dec-07		Feb-08
				Sample	Duplicate		Sample	Duplicate	
Inorganics, Total (µg/L) (Continued)									
SELENIUM	50	NA	NA	1.5 U	2 J	1.5 U	1.5 U	1.5 U	2.2 U
SILVER	12	NA	NA	0.46 U	0.46 U	1.5	0.46 U	0.46 U	0.54 U
SODIUM	NUT	NA	NA	46,900	49,600	52,100	53,400	52,300	50,100
VANADIUM	NE	NA	NA	1.3 U	1.4 U	3.7	0.34 U	0.29 U	0.52 U
ZINC	123	NA	200	21.3 J	22.3	47.1	22.8	20	26.6
Inorganics, Filtered (µg/L)									
ALUMINUM	NE	NA	NA	20.4 J	36.7 J	21.3 J	19.0 U	19.0 U	35.4
ARSENIC	4	NA	NA	3.5 U	2.2 U	1.2 J	1.9 U	1.1 U	2.8
BARIUM	NE	NA	NA	44.6	46.4	50.1	48.9	49.6	56.8
CALCIUM	NUT	NA	NA	33,600	34,700	31,400	33,100	33,400	36,000
CHROMIUM	110 [2]	NA	NA	1.2 U	0.44 U	0.3 J	0.29	0.48	0.38 U
COBALT	NE	NA	NA	0.67 U	0.86 U	0.47 J	0.48	0.51	0.64
IRON	NUT	NA	NA	3,470	3,630	3,600	4,190	4,140	3,750
LEAD	13	NA	30	1.3 J	1.8 J	1.1 U	2.1 U	2.8 U	1.4 U
MAGNESIUM	NUT	NA	NA	7,200	7,480	6,980	7,250	7,300	8,020
MANGANESE	NE	NA	NA	645	664	708	764	770	815
NICKEL	880	NA	NA	1.1 U	0.88 U	0.78 J	1	0.64	0.66
POTASSIUM	NUT	NA	NA	5,090	5,390	5,320	5,360	5,390	5,390
SELENIUM	50	NA	NA	1.5 U	1.7 J	2.4 U	1.5 U	2.3 U	2.2 U
SODIUM	NUT	NA	NA	46,600	48,400	52,600	50,400	51,400	52,100
ZINC	123	NA	200	21.4 J	19.5 J	15	18.6	20.8	26
Petroleum Hydrocarbons (µg/L)									
ETPH (C09-C36)	NE	NE	2,500[1]	55 J	79 U	140 J	160 U	1,600 J	75 U
Petroleum Hydrocarbons, Filtered (µg/L)									
ETPH (C09-C36)	NE	NE	2,500[1]	NA	NA	NA	NA	NA	75 U

1 - Criterion is for oil and grease.
2 - Criterion is for hexavalent chromium.
Shaded cells indicate exceedances of criteria.
NA - Not applicable.
NE - Not established.
NUT Essential nutrient.
U - Not detected at associated detection limit.
J - Estimated concentration.

TABLE 2-7

SELECTION OF HUMAN HEALTH RISK ASSESSMENT EXPOSURE PATHWAYS FOR OPERABLE UNIT 9
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Groundwater	Groundwater	Overburden/ Bedrock Aquifer	Construction Workers	Adult	Ingestion Dermal	On-Site On-Site	None Quant	Construction workers may have dermal contact with groundwater during excavation activities.
				Residents	Adult	Ingestion Dermal	On-Site On-Site	Quant Quant	Groundwater may be used as a potable water source in the future.
					Child	Ingestion Dermal	On-Site On-Site	None None	Exposures to a child resident are less than those for an adult resident
		Air		Construction Workers	Adult	Inhalation	On-site	None	Construction workers exposure via volatilization is expected to be insignificant due to dilution with outdoor air.
				Residents	Adult	Inhalation	On-site	Quant	On-site residents may be exposed to volatile emissions from groundwater while showering.
					Child	Inhalation	On-site	None	Exposures to a child resident are less than those for an adult resident

TABLE 2-8

SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR SITE 3 GROUNDWATER
REASONABLE MAXIMUM EXPOSURES
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
Construction Worker	Groundwater	Dermal Contact	1.3E-06	--	--	--	0.001	--
Adult Resident	Groundwater	Ingestion	5.1E-04	Arsenic	Vinyl Chloride, Benzo(a)pyrene, Dibenzo(a,h)anthracene	1,1,2-Trichloroethane, Indeno(1,2,3-cd)pyrene, alpha-BHC	2.4	Arsenic
		Dermal Contact	8.6E-04	Benzo(a)pyrene, Dibenzo(a,h)anthracene	Indeno(1,2,3-cd)pyrene	alpha-BHC, Arsenic	0.009	--
		Inhalation[1]	1.9E-05	--	Vinyl Chloride	1,1,2-Trichloroethane	0.04	--
		Total	1.4E-03	Benzo(a)pyrene, Dibenzo(a,h)anthracene, Arsenic	Vinyl Chloride, Indeno(1,2,3-cd)pyrene	1,1,2-Trichloroethane, alpha-BHC	2.4	Arsenic

Taken from Basewide Groundwater Operable Unit Remedial Investigation Update/Feasibility Study (TtNUS, 2004).

1 Inhalation risk is assumed to be equal to risk from ingestion for volatiles.

TABLE 2-9

SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR SITE 3 GROUNWATER
CENTRAL TENDENCY EXPOSURES
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
Construction Worker	Groundwater	Dermal Contact	4.4E-07	--	--	--	0.0003	--
Adult Resident	Groundwater	Ingestion	7.1E-05	--	Arsenic	Vinyl Chloride, Benzo(a)pyrene, Dibenzo(a,h)anthracene	1.1	Arsenic
		Dermal Contact	1.4E-04	--	Benzo(a)anthracene, Dibenzo(a,h)anthracene	Indeno(1,2,3-cd)pyrene	0.005	--
		Inhalation(1)	2.6E-06	--	--	Vinyl Chloride	0.02	--
		Total	2.2E-04	--	Benzo(a)anthracene, Dibenzo(a,h)anthracene, Arsenic	Vinyl Chloride, Indeno(1,2,3-cd)pyrene	1.1	Arsenic

Taken from Basewide Groundwater Operable Unit Remedial Investigation Update/Feasibility Study (TtNUS, 2004).

1 Inhalation risk is assumed to be equal to risk from ingestion for volatiles.

TABLE 2-10

SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR SITE 7 GROUNDWATER
REASONABLE MAXIMUM EXPOSURES
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals with HI > 1
Construction Worker	Groundwater	Dermal Contact	4.2E-07	- -	- -	- -	0.09	- -
Adult Resident	Groundwater	Ingestion	3.2E-04	Arsenic	Bis(2-ethylhexyl)phthalate, 1,4-Dichlorobenzene, Hexachlorobenzene	Benzene, Trichloroethene	3.8	Arsenic, Chromium
		Dermal Contact	2.9E-04	Hexachlorobenzene	Bis(2-ethylhexyl)phthalate, 1,4-Dichlorobenzene	- -	1.3	- -
		Inhalation[1]	3E-05	- -	1,4-Dichlorobenzene	Benzene, Trichloroethene	0.5	- -
		Total	6.4E-04	Arsenic, Hexachlorobenzene	Bis(2-ethylhexyl)phthalate, 1,4-Dichlorobenzene	Benzene, Trichloroethene	5.6	Arsenic, Chromium

Taken from Basewide Groundwater Operable Unit Remedial Investigation Report (TtNUS, 2002a).

1 Inhalation risk is assumed to be equal to risk from ingestion for volatiles.

TABLE 2-11

SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR SITE 7 GROUNDWATER
CENTRAL TENDENCY EXPOSURES
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
Construction Worker	Groundwater	Dermal Contact	1.0E-07	--	--	--	0.05	--
Adult Resident	Groundwater	Ingestion	1.2E-05	--	--	Arsenic, Hexachlorobenzene	0.2	--
		Dermal Contact	3.2E-05	--	Hexachlorobenzene	--	0.8	--
		Inhalation[1]	8.5E-08	--	--	--	0.02	--
		Total	4.4E-05	--	Hexachlorobenzene	Arsenic, Bis(2-ethylhexyl)phthalate	1.1	--

Taken from Basewide Groundwater Operable Unit Remedial Investigation Report (TtNUS, 2002a).

1 Inhalation risk is assumed to be equal to risk from ingestion for volatiles.

TABLE 2-12

COMPARISONS OF SITE 14 GROUNDWATER ANALYTICAL RESULTS
TO SCREENING CRITERIA
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Parameter	S14MW01S	Basewide Background[1]	EPA Region 9 PRG[2]	CTDEP GA/GAA Criterion[3]	EPA MCL[4]	Connecticut MCL[5]	CTDEP RSR Surface Water Protection Criterion[3]
Total Metals (µg/L)							
BARIUM	48.8	227	2600 N	1000	2000	2000	NA
CALCIUM	6890	188000	NA	NA	NA	NA	NA
IRON	1330	28200	11000 N	NA	300 [6]	NA	NA
MAGNESIUM	3060	19100	NA	NA	NA	NA	NA
MANGANESE	88.2	11700	880 N	NA	50 [6]	NA	NA
POTASSIUM	2780	70800	NA	NA	NA	NA	NA
SODIUM	31500	1900000	NA	NA	NA	NA	NA
Miscellaneous Parameters (mg/L)							
TOTAL DISSOLVED SOLIDS	122 J	6260	NA	NA	500 [6]	NA	NA

Taken from Basewide Groundwater Operable Unit Remedial Investigation Update/Feasibility Study (TtNUS, 2004).

NA - Not available.
RBC - Risk-Based Concentration.
PRG - Preliminary Remediation Goal.
MCL - Maximum Contaminant Level.
1 - 96 Percent Upper Tolerance Limit of site background data. BGOURI Report (TtNUS, 2002a).
2 - EPA Region 9 PRG Table, Residential, 2002b (ICR = 1E-6, HQ = 1.0).
3 - CTDEP Residnetial Remediation Standard Regulations, 1996.
4 - EPA Drinking Water Standards and Health Advisories, 2002a.
5 - Title 19, Health and Safety, the Public Code of the State of Connecticut.
6 - Secondary MCL.
J - Estimated concentration.

TABLE 2-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR SITE 15
REASONABLE MAXIMUM EXPOSURES
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
Construction Worker	Surface/Subsurface Soil	Ingestion	3.5E-07	--	--	--	0.2	--
		Dermal Contact	1.7E-08	--	--	--	0.003	--
		Total	3.7E-07	--	--	--	0.2	--
	Groundwater	Dermal Contact	NC	--	--	--	0.002	--
		Total All Media	3.7E-07				0.2	
Full-Time Employees	Surface Soil[1]	Ingestion	2.3E-06	--	--	Arsenic	0.05	--
		Dermal Contact	5.2E-07	--	--	--	0.004	--
		Total	2.8E-06	--	--	Arsenic	0.06	--
Adolescent Trespasser	Surface Soil[1]	Ingestion	1.2E-06	--	--	Arsenic	0.07	--
		Dermal Contact	2.2E-07	--	--	--	0.004	--
		Total	1.4E-06	--	--	Arsenic	0.07	--
Child Resident	Surface/Subsurface Soil	Ingestion	5.1E-06	--	--	Arsenic	0.5	--
		Dermal Contact	3.1E-07	--	--	--	0.01	--
		Total	5.4E-06	--	--	Arsenic	0.5	--
Adult Resident	Surface/Subsurface Soil	Ingestion	2.2E-06	--	--	Arsenic	0.05	--
		Dermal Contact	1.7E-07	--	--	--	0.001	--
		Total	2.4E-06	--	--	Arsenic	0.05	--
	Groundwater	Ingestion	NC	--	--	--	0.2	--
		Dermal Contact	NC	--	--	--	0.01	--
		Inhalation[2]	NC	--	--	--	0	--
		Total	NC	--	--	--	0.3	--
		Total All Media	2.4E-06				0.3	

From Basewide Groundwater Operable Unit Remedial Investigation Update/Feasibility Study (TtNUS, 2004).
1 - Assumes the pavement is removed.
2 - Inhalation risk is assumed to be equal to risk from ingestion for volatiles.
NC - Not calculated. There were no carcinogenic COPCs identified for groundwater.

TABLE 2-14

SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR SITE 15
CENTRAL TENDENCY EXPOSURES
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals with HI > 1
Construction Worker	Surface/Subsurface Soil	Ingestion	1.2E-07	--	--	--	0.07	--
		Dermal Contact	1.1E-09	--	--	--	0.0002	--
		Total	1.2E-07	--	--	--	0.07	--
	Groundwater	Dermal Contact	NC	--	--	--	0.0005	--
		Total All Media	1.2E-07				0.07	
Full-Time Workers	Surface Soil[1]	Ingestion	2.7E-07	--	--	--	0.03	--
		Dermal Contact	1.2E-08	--	--	--	0.0004	--
		Total	2.9E-07	--	--	--	0.03	--
Adolescent Trespasser	Surface Soil[1]	Ingestion	7.7E-08	--	--	--	0.01	--
		Dermal Contact	8.8E-09	--	--	--	0.0006	--
		Total	8.6E-08	--	--	--	0.01	--
Child Resident	Surface/Subsurface Soil	Ingestion	8.5E-07	--	--	--	0.2	--
		Dermal Contact	1.8E-08	--	--	--	0.002	--
		Total	8.7E-07	--	--	--	0.2	--
Adult Resident	Surface/Subsurface Soil	Ingestion	3.2E-07	--	--	--	0.03	--
		Dermal Contact	7.3E-09	--	--	--	0.0002	--
		Total	3.3E-07	--	--	--	0.03	--
	Groundwater	Ingestion	NC	--	--	--	0.1	--
		Dermal Contact	NC	--	--	--	0.005	--
		Inhalation[2]	NC	--	--	--	0	--
		Total	NC	--	--	--	0.1	--
		Total All Media	3.3E-07				0.1	

From Basewide Groundwater Operable Unit Remedial Investigation Update/Feasibility Study (TtNUS, 2004).

1 - Assumes the pavement is removed.
2 - Inhalation risk is assumed to be equal to risk from ingestion for volatiles.
NC - Not calculated. There were no carcinogenic COPCs identified for groundwater.

TABLE 2-15

SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR SITE 20 GROUNDWATER
REASONABLE MAXIMUM EXPOSURES
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
Construction Worker	Groundwater	Dermal Contact	1.3E-09	- -	- -	- -	0.0002	- -
		Inhalation	1.1E-08	- -	- -	- -	--	- -
		Total	1.2E-08	- -	- -	- -	0.0002	- -
Adult Resident	Groundwater	Ingestion	6.4E-05	- -	Arsenic	Benzo(a)pyrene	0.3	- -
		Dermal Contact	2.1E-07	- -	- -	- -	0.0007	- -
		Inhalation[1]	7.7E-07	- -	- -	- -	--	- -
		Total	6.5E-05	- -	Arsenic	Benzo(a)pyrene	0.3	- -

Risks were calculated using organic sampling results from the BGOURI (TtNUS, 2002a) and inorganic sampling results from the BGOURI Update/FS (TtNUS, 2004).

1 - Inhalation risk is assumed to be equal to risk from ingestion for volatiles.

TABLE 2-16

SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR SITE 20 GROUNDWATER
CENTRAL TENDENCY EXPOSURES
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
Construction Worker	Groundwater	Dermal Contact	3.3E-10	--	--	--	0.00004	--
		Inhalation	2.7E-09	--	--	--	--	--
		Total	3.0E-09	--	--	--	0.00004	--
Adult Resident	Groundwater	Ingestion	8.6E-06	--	--	Arsenic	0.1	--
		Dermal Contact	3.1E-08	--	--	--	0.0003	--
		Inhalation[(1)]	1.1E-07	--	--	--	--	--
		Total	8.8E-06	--	--	Arsenic	0.1	--

Risks were calculated using organic sampling results for the BGOURI (TtNUS, 2002a) and inorganic results for the BGOURI Update/FS (TtNUS, 2004).

1 - Inhalation risk is assumed to be equal to risk from ingestion for volatiles.

TABLE 2-17
SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR SITE 23
REASONABLE MAXIMUM EXPOSURES
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10-4	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to HI > 1
Construction Worker	Groundwater	Dermal Contact	1.3E-09	--	--	--	0.0002	--
Adult Resident	Groundwater	Ingestion	1.8E-06	--	--	Tetrachloroethene	0.01	--
		Dermal Contact	8.5E-07	--	--	--	0.005	--
		Inhalation[1]	1.8E-06	--	--	Tetrachloroethene	0.008	--
		Total	4.5E-06	--	--	Tetrachloroethene	0.02	--

1 - Inhalation risk is assumed to be equal to risk fom ingestion for volatiles.

TABLE 2-18

SELECTION OF ECOLOGICAL COPCs IN GROUNDWATER AT SITE 3 - NSA
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Chemicals Detected in Groundwater	Detection Frequency[1]	Minimum Concentration [2]	Maximum Concentration [2]	Location of Maximum Concentration	Background Concentration[3]	Surface Water Screening Value	Ecological Effects Quotient[4]	Retain as a COPC?	Rationale for COPC Selection or Elimination[5]
Volatile Organics (µg/L)									
1,1,2-TRICHLOROETHANE	1/5	2 J	2 J	S3GW3TW2701	--	1200	0.002	NO	BSL
CIS-1,2-DICHLOROETHENE	4/5	0.7 J	3	S3GW2DMW29S04 S3GW3TW2801-D	--	590	0.01	NO	BSL
TOLUENE	2/5	0.2 J	0.3 J	S3GW3TW2701 S3GW3TW2801	--	9.8	0.03	NO	BSL
TOTAL 1,2-DICHLOROETHENE	2/2	0.7 J	3	S3GW2DMW29S04	--	590	0.01	NO	BSL
TRANS-1,2-DICHLOROETHENE	1/5	0.2 J	0.2 J	S3GW3TW2801 S3GW3TW2801-D	--	590	0.0003	NO	BSL
TRICHLOROETHENE	3/5	0.5 J	2	S3GW3TW2801-D	--	47	0.04	NO	BSL
VINYL CHLORIDE	3/5	0.3 J	2 J	S3GW3TW2701	--	NA	--	YES	NTX
Semivolatile Organics (µg/L)									
ACENAPHTHENE	2/5	0.11 J	0.13 J	S3GW3TW2801 S3GW3TW2801-D	--	23	0.01	NO	BSL
BENZO(A)PYRENE	1/5	0.13 J	0.13 J	S3GW3TW2801	--	0.014	9.29	YES	ASL
BENZO(G,H,I)PERYLENE	1/5	0.28	0.28	S3GW3TW2801	--	NA	--	YES	NTX
BENZO(K)FLUORANTHENE	1/5	0.08 J	0.08 J	S3GW3TW2801	--	NA	--	YES	NTX
DIBENZO(A,H)ANTHRACENE	1/5	0.3	0.3	S3GW3TW2801	--	NA	--	YES	NTX
FLUORENE	2/5	0.24 J	0.36 J	S3GW3TW2801	--	3.9	0.1	NO	BSL
INDENO(1,2,3-CD)PYRENE	1/5	0.35	0.35	S3GW3TW2801	--	NA	--	YES	NTX
Pesticides/PCBs(µg/L)									
ALPHA-BHC	1/3	0.025	0.028	S3GW3TW2801	--	2.2	0.01	NO	BSL
BETA-BHC	1/2	0.015 J	0.017	S3GW3TW2801-D	--	2.2	0.01	NO	BSL
Total Metals(µg/L)									
ALUMINUM	2/3	732 J	6780 J	S3GW3TW2701	3560	87	78	YES	ASL
ARSENIC	2/5	2 J	25.4	S3GW2DMW29S04	1.92	150	0.17	NO	BSL
BARIUM	3/3	30	74.8	S3GW3TW3001	227	4	18.7	YES	ASL
CALCIUM	3/3	13300	19100	S3GW3TW3001	188,000	NA	--	NO	EN
CHROMIUM	2/3	5.8	8.4	S3GW3TW2701	49.9	11	0.76	NO	BSL
COPPER	2/3	4.3	14.2	S3GW3TW2801	107	4.8	2.96	YES	ASL
IRON	2/3	18000	20000	S3GW3TW2801	28,200	1000	20	YES	ASL
LEAD	2/3	2.2	8.4	S3GW3TW2701	6.63	1.2	7	YES	ASL
MAGNESIUM	3/3	4410	5770	S3GW3TW3001	191,000	NA	--	NO	EN
MANGANESE	3/3	56.7	764	S3GW3TW2701	11,700	120	6.4	YES	ASL
POTASSIUM	3/3	3650	4540	S3GW3TW2801-D	70,800	NA	--	NO	EN
SODIUM	3/3	52400	68800	S3GW3TW3001	1,900,000	NA	--	NO	EN
VANADIUM	2/3	12.1	12.1	S3GW3TW2701 S3GW3TW2801	10.2	NA	--	YES	NTX

TABLE 2-18

SELECTION OF ECOLOGICAL COPCs IN GROUNDWATER AT SITE 3 - NSA
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Chemicals Detected In Groundwater	Detection Frequency[1]	Minimum Concentration [2]	Maximum Concentration [2]	Location of Maximum Concentration	Background Concentration[3]	Surface Water Screening Value	Ecological Effects Quotient[4]	Retain as a COPC?	Rationale for COPC Selection or Elimination[5]
Filtered Metals(ug/L)									
ARSENIC-FILTERED	2/5	2 J	3.5	S3GW2DMW29S04-F	2.55	150	0.02	NO	BSL
BARIUM-FILTERED	3/3	23.1	75.6	S3GW3TW3001-F	124	4	18.9	YES	ASL
CALCIUM-FILTERED	3/3	13800	19100	S3GW3TW3001-F	152,000	NA	--	NO	EN
IRON-FILTERED	2/3	12000	15200	S3GW3TW2801-F-D	25,300	1000	15.2	YES	ASL
MAGNESIUM-FILTERED	3/3	3730	5810	S3GW3TW3001-F	150,000	NA	--	NO	EN
MANGANESE-FILTERED	3/3	58.6	496	S3GW3TW2701-F	9,400	120	4.13	YES	ASL
POTASSIUM-FILTERED	3/3	3650	4870	S3GW3TW2801-F-D	60,000	NA	--	NO	EN
SODIUM-FILTERED	3/3	55600	69400	S3GW3TW3001-F	1,580,000	NA	--	NO	EN

Taken from Basewide Groundwater Operable Unit Remedial Investigaiton Update/Feasibility Study.(TtNUS, 2004).

1 Sample and duplicate were counted as one sample when calculating the frequency of detection.
2 Sample and duplicate were counted as separate samples in determining the minimum and maximum concentrations.
3 Source of the background concentrations is Atlantic, April 1995. Background concentrations of Inorganics in Soil - NSB-NLON.
4 The ecological effects quotient was calculated by dividing the maximum concentration by the screening value.
5 Rationale codes for contaminant selection or deletion:
  For Selection as a COPC:
    ASL = Above COPC screening level.
    NTX = No toxicity information available.
  For Elimination as a COPC:
    BSL = Below COPC screening level.
    EN = Essential Nutrient.

The background concentrations are presented for informational purposes only and were not used in the selection of COPCs.
Shaded name indicates that the constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.
"--" Unavailable; background concentrations are not available for organic chemicals and an EEQ could not be calculated due to the lack of screening values.
J = Estimated concentration.

TABLE 2-19

SITE 3 REMEDIAL GOALS
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Chemical of Concern	Groundwater Criteria		Remedial Goal
	Federal MCL[(1)]	Connecticut RSRs for Groundwater[(2)]	
Volatile Organic Compounds (µg/L)			
Trichloroethene	5	5	5
Vinyl Chloride	2	2[A] / 1.6[B]	1.6

1 Maximum Contaminant Level (MCL) for drinking water (EPA, 2004).
2 Connecticut Remediation Standard Regulations
A - Groundwater Protection Criteria for groundwater classified as GA (CTDEP, 1996).
B - Groundwater Volatilization Criteria (CTDEP, 2007).

TABLE 2-20

SITE 7 REMEDIAL GOALS
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Chemical of Concern	Groundwater Criteria		Remedial Goal
	Federal MCL[1]	Connecticut RSRs for Groundwater[2]	
Volatile Organic Compounds (µg/L)			
1,4-Dichlorobenzene	75	75	75
Benzene	5	1	1
Chlorobenzene	100	100	100
Trichloroethene	5	5	5
Vinyl Chloride	2	2^A / 1.6^B	1.6
Semivolatile Organic Compounds (µg/L)			
Hexachlorobenzene	1	1	1

1 Maximum Contaminant Level (MCL) for drinking water (EPA, 2004).
2 Connecticut Remediation Standard Regulations;
A - Groundwater Protection Criteria for groundwater classified as GA (CTDEP, 1996).
B - Groundwater Volatilization Criteria (CTDEP, 2007).

TABLE 2-21

ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVES GW1-1, GW2-1, AND GW3-1 - NO ACTION
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
Federal				
Cancer Slope Factors	Not Applicable	To Be Considered (TBC)	These are guidance values used in risk assessment to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	The No Action Alternatives would result in unacceptable risks from exposure to contaminated groundwater. Because no restrictions on groundwater use would be implemented under the No Action Alternatives, future groundwater use could result in unacceptable risks to receptors.
References Doses	Not Applicable	TBC	These are guidance values used in risk assessment to evaluate the potential non-carcinogenic hazard caused by exposure to contaminants.	The No Action Alternatives would result in unacceptable risks from exposure to contaminated groundwater. Because no restrictions on groundwater use would be implemented under the No Action Alternatives, future groundwater use could result in unacceptable risks to receptors.
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	TBC	Guidance for assessing cancer risk from exposures to pollutants and other agents in the environment. As part of the characterization process, explicit evaluations are made of the hazard and risk potential for susceptible lifestages, including children.	The No Action Alternatives would result in unacceptable risks from exposure to contaminated groundwater. Because no restrictions on groundwater use would be implemented under the No Action Alternatives, future groundwater use could result in unacceptable risks to receptors.

TABLE 2-21

ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVES GW1-1, GW2-1, AND GW3-1 - NO ACTION
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
Federal (continued)				
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	TBC	Guidance for assessing cancer risks to children. Addresses a number of issues pertaining to cancer risks associated with early-life exposures and also provides specific guidance on potency adjustments for carcinogens acting through the mutagenic mode of action.	The No Action Alternatives would result in unacceptable risks from exposure to contaminated groundwater. Because no restrictions on groundwater use would be implemented under the No Action Alternatives, future groundwater use could result in unacceptable risks to receptors.
State of Connecticut				
Remediation Standard Regulations	CGS 22a-133k; RCSA 22a-133k - 1 through 3	Applicable	This regulation provides specific numerical cleanup criteria for contaminants in groundwater. Requirements are based on groundwater in the area being classified by the state as GB.	The No Action Alternatives would not meet this standard because no action would be taken to determine if regulatory standards continued to be exceeded.

TABLE 2-22

ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs FOR GROUNDWATER ALTERNATIVES GW1-2 AND GW2-2 - SELECTED REMEDY OPERABLE UNIT 9 RECORD OF DECISION NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
Federal				
Cancer Slope Factors	Not Applicable	To Be Considered (TBC)	These are guidance values used in risk assessment to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Alternatives would prevent exposure to contaminated groundwater and monitor the migration and degradation of contaminants until concentrations have achieved acceptable levels that meet human health concerns.
Reference Doses	Not Applicable	TBC	These are guidance values used in risk assessment to evaluate the potential non-carcinogenic hazard caused by exposure to contaminants.	Alternatives would prevent exposure to contaminated groundwater and monitor the migration and degradation of contaminants until concentrations have achieved acceptable levels that meet human health concerns.
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	TBC	Guidance for assessing cancer risk from exposures to pollutants and other agents in the environment. As part of the characterization process, explicit evaluations are made of the hazard and risk potential for susceptible lifestages, including children.	Alternatives will meet this standard because potential carcinogenic risks caused by exposure to contaminants will be addressed.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	TBC	Guidance for assessing cancer risks to children. Addresses a number of issues pertaining to cancer risks associated with early-life exposures and also provides specific guidance on potency adjustments for carcinogens acting through the mutagenic mode of action.	Alternatives will meet this standard because potential carcinogenic risks caused by exposure to contaminants will be addressed.

TABLE 2-22

ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs FOR GROUNDWATER ALTERNATIVES GW1-2 AND GW2-2 - SELECTED REMEDY OPERABLE UNIT 9 RECORD OF DECISION NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
State of Connecticut				
Remediation Standard Regulations	CGS 22a-133k; RCSA 22a-133k - 1 through 3	Applicable	This regulation provides specific numerical cleanup criteria for contaminants in groundwater. Requirements are based on groundwater in the area being classified by the state as GB.	Alternatives will meet these standards by restricting access to contaminated GB groundwater through institutional controls (NSB-NLON Site Use Restrictions document for as long as the Navy owns the property) or environmental land use restrictions (if the Navy transfers ownership of the property). Groundwater monitoring would be conducted to track the location, migration, and degradation of contaminants until concentrations have achieved acceptable levels.

TABLE 2-23

ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVES GW1-2 AND GW2-2 - SELECTED REMEDY
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
Federal				
Clean Water Act, Section 403, Pretreatment Regulations	Section 403	Potentially Applicable	General pretreatment requirements for discharge to a publicly owned treatment works (POTW).	Groundwater extracted during groundwater monitoring activities under this alternative would require testing and disposal. Discharge to a POTW would be considered for disposal of the groundwater, and these requirements would be met if determined to be applicable.
State of Connecticut				
Hazardous Waste Management: Generator and Handler Requirements	RCSA § 22a-449(c) 100-101	Applicable	Connecticut is delegated to administer the federal Resource Conservation and Recovery Act statute through its state regulations. These sections establish standards for listing and identification of hazardous waste. The standards of 40 CFR 260-261 are incorporated by reference.	Waste generated during the installation of monitoring wells and monitoring activities under these alternatives will be properly characterized for disposal. Any waste determined to be hazardous through characterization will be managed in accordance with these regulations.
Hazardous Waste Management: Treatment, Storage, or Disposal Facility Standards	RCSA § 22a-449(c) 104	Applicable	These sections establish standards for treatment, storage, and disposal facilities. The standards of 40 CFR 264 are incorporated by reference.	Any hazardous waste generated during the installation of monitoring wells and monitoring activities and temporarily stored on site will be managed in accordance with these regulations.

TABLE 2-23

ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVES GW1-2 AND GW2-2 - SELECTED REMEDY
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
State of Connecticut (continued)				
Standards of Water Quality/Water Quality Standards (WQSs) IV	CGS 22a-426 and promulgated standards	Applicable	Standards have been promulgated in accordance with GCS22a-426 of the Connecticut General Statutes to preserve and enhance the quality of state groundwater and surface water. Groundwater at the sites is classified as GB.	These standards for groundwater will be met through monitoring of natural degradation processes. Institutional controls will prevent the aquifer from being used as a water supply until these standards are attained.
Connecticut Regulations for the Well Drilling Industry	RSCA 25-128-33 through 64	Applicable	These rules apply mainly to any new water supply or withdrawal wells. The rules specify that non-water supply wells must be constructed so that they are not a source or cause of groundwater contamination. Procedures for abandonment of wells apply to both water wells and other types of wells.	Non-water supply wells will not be constructed on the site unless it can be shown that they will not be a source of or cause groundwater contamination.
Connecticut Water Pollution Control Act - Permitting Regulations	RSCA 22a-430 1-8	Relevant and Appropriate	Establishes permitting requirements for discharges to surface water, groundwater, and POTWs.	If any remedial activities result in any direct discharges to surface water or groundwater, they must comply with the substantive requirements of these regulations. Specific criteria may be established for discharges so that numeric criteria established in the WQSs are not violated.

TABLE 2-23

ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVES GW1-2 AND GW2-2 - SELECTED REMEDY
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
State of Connecticut (continued)				
Connecticut Environmental Land Use Restriction Regulations	RCSA 22A-133q-1	Applicable	Requirements to prevent disturbance of contaminated soil and to ensure that contaminated groundwater is not used for human consumption.	Implementation of environmental land use restrictions including deed restrictions.
Connecticut Soil Vapor Remediation Standards Regulations	RCSA 22a-133k-3(c)	Applicable	These standards establish volatilization criteria to address volatile organic substances in groundwater and soil vapor.	For areas where data show the potential for an unacceptable indoor inhalation risk, remedial actions (e.g., sub-slab depressurization systems) will be applied, as needed, to comply with the substantive provisions of these regulations.

TABLE 2-24

ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER ALTERNATIVES GW1-2 AND GW2-2 – SELECTED REMEDY OPERABLE UNIT 9 RECORD OF DECISION NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
FEDERAL				
Coastal Zone Management Act	16 USC Parts 1451 et. seq.	Applicable	Requires that any actions must be conducted in a manner consistent with state-approved management programs.	The actions associated with these alternatives would comply with the substantive requirements of this act.
Floodplain Management	40 C.F.R. §6.302(b); Appendix A	Applicable	This regulation codifies standards established under Executive Order 11988 and requires action to avoid long- and short-term impacts associated with occupancy and modifications related to floodplain development, wherever there is a practicable alternative. Promotes the preservation and restoration of floodplains so that their natural and beneficial value can be realized.	If there is no practicable alternative to groundwater monitoring activities within the 100-year floodplain, all practicable means will be taken to limit harm to and preserve beneficial values of floodplains.
Protection of Wetlands	40 C.F.R. §6.302(a); Appendix A	Applicable	This regulation codifies standards established under Executive Order 11990. Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent.	If there is no practicable alternative to groundwater monitoring activities that may impact wetlands, measures will be taken to limit impacts.
Clean Water Act Guidelines for Specification of Disposal Sites for Dredged or Fill Material	33 USC §1344; Section 404(b)(1) 40 C.F.R. Parts 230 and 231 and 33 C.F.R. Parts 320 through 323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. This act controls discharges of dredged or fill material to protect aquatic ecosystems.	These alternatives may include installation, maintenance and/or operation of monitoring wells in or near a wetland. Any remedial activities that will alter wetlands will be conducted in accordance with these standards.

TABLE 2-24

ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER ALTERNATIVES GW1-2 AND GW2-2 – SELECTED REMEDY OPERABLE UNIT 9 RECORD OF DECISION NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
STATE OF CONNECTICUT				
Connecticut Coastal Management Act	CGS §22a-444	Applicable	The sites are in a coastal zone management area; therefore, requirements for site planning must include approval of activities within the coastal zone to minimize project impacts to this area.	The activities associated with these alternatives would comply with the substantive requirements of this act.
Inland Wetland and Watercourses Act and Regulations	CGS 22a-36 through 45; RCSA 22a-39-1 through 15	Applicable	These standards regulate any operation in or affecting an inland wetland or watercourse, involving removal or deposition of material or any obstruction, alteration, or pollution of such wetlands. The standards incorporate local wetland regulations, which include additional substantive requirements and a wetland and watercourse boundary map for the Town of Groton.	If there is no practicable alternative to groundwater monitoring activities that may impact designated wetlands or watercourses, measures will be taken to limit impacts.

TABLE 2-25

ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVE GW2-3 – EXTRACTION AND OFF-SITE DISCHARGE
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
Federal				
Cancer Slope Factors	Not Applicable	To Be Considered (TBC)	These are guidance values used in risk assessment to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Alternative would remove contaminated groundwater from the sites, pre-treat the extracted water if necessary, and discharge the water to the publicly owned treatment works (POTW) for final treatment and discharge. After removal of groundwater with contaminant concentrations greater than acceptable levels from the sites, there would be no remaining unacceptable risks to human health.
Reference Doses	Not Applicable	TBC	These are guidance values used in risk assessment to evaluate the potential non-carcinogenic hazard caused by exposure to contaminants.	Alternative would remove contaminated groundwater from the sites, pre-treat the extracted water, if necessary, and discharge the water to the POTW for final treatment and discharge. After removal of groundwater with contaminant concentrations greater than acceptable levels from the sites, there would be no remaining unacceptable risks to human health.
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	TBC	Guidance for assessing cancer risk from exposures to pollutants and other agents in the environment. As part of the characterization process, explicit evaluations are made of the hazard and risk potential for susceptible lifestages, including children.	Alternative will meet this standard because potential carcinogenic risks caused by exposure to contaminants will be addressed.

TABLE 2-25

ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVE GW2-3 – EXTRACTION AND OFF-SITE DISCHARGE
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
Federal (continued)				
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	TBC	Guidance for assessing cancer risks to children. Addresses a number of issues pertaining to cancer risks associated with early-life exposures and also provides specific guidance on potency adjustments for carcinogens acting through the mutagenic mode of action.	Alternative will meet this standard because potential carcinogenic risks caused by exposure to contaminants will be addressed.
State of Connecticut				
Remediation Standard Regulations	CGS 22a-133k; RCSA 22a-133k - 1 through 3	Applicable	This regulation provides specific numerical cleanup criteria for contaminants in groundwater. Requirements are based on groundwater in the area being classified by the state as GB.	Groundwater extraction would continue until contaminants concentrations have achieved acceptable levels.

TABLE 2-26

ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVE GW2-3 - EXTRACTION AND OFF-SITE DISCHARGE
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
Federal				
Clean Water Act, Section 403, Pretreatment Regulations	Section 403	Potentially Applicable	General pretreatment requirements for discharge to a publicly owned treatment works (POTW). If remedial activities include such a discharge to the local sanitary sewer, pre-treatment standards would be Applicable or Relevant and Appropriate Requirements (ARARs). Standards would be enforced through the state program.	The extracted water may require pre-treatment prior to discharge to the sanitary sewer system. Groundwater extracted during groundwater monitoring activities under this alternative will require testing and disposal. Discharge to a POTW would be considered for disposal of the groundwater, and these requirements would be met if determined to be applicable.
State of Connecticut				
Hazardous Waste Management: Generator and Handler Requirements	RCSA § 22a-449(c) 100-101	Applicable	Connecticut is delegated to administer the federal Resource Conservation and Recovery Act statute through its state regulations. These sections establish standards for listing and identification of hazardous waste. The standards of 40 CFR 260-261 are incorporated by reference.	Waste generated during the installation of extraction wells and extraction activities, as well as monitoring, under this alternative will be properly characterized for disposal. Any waste determined to be hazardous through characterization will be managed in accordance with these regulations.
Hazardous Waste Management: Treatment, Storage, or Disposal Facility Standards	RCSA § 22a-449(c) 104	Applicable	These sections establish standards for treatment, storage, and disposal facilities. The standards of 40 CFR 264 are incorporated by reference.	Any hazardous waste generated during the installation of extraction wells and extraction activities, as well as monitoring, and temporarily stored on site will be managed in accordance with these regulations.

TABLE 2-26

ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVE GW2-3 - EXTRACTION AND OFF-SITE DISCHARGE
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
State of Connecticut (continued)				
Standards of Water Quality/Water Quality Standards (WQSs) IV	CGS 22a-426 and promulgated standards	Applicable	Standards have been promulgated in accordance with GCS22a-426 of the Connecticut General Statutes to preserve and enhance the quality of state groundwater and surface water. Groundwater at the sites is classified as GB.	These standards for groundwater will be met through monitoring of natural degradation processes. Institutional controls will prevent the aquifer from being used as a water supply until these standards are attained.
Connecticut Water Pollution Control Act	RCSA §22a - 416 to 599	Applicable	The regulations govern the treatment and discharge of water into surface water bodies in the state.	Applicable sections of the POTW permit would be used to determine pre-treatment requirements for extracted groundwater.
Connecticut Regulations for the Well Drilling Industry	RSCA 25-128-33 through 64	Applicable	These rules apply mainly to any new water supply or withdrawal wells. The rules specify that non-water supply wells must be constructed so that they are not a source or cause of groundwater contamination. Procedures for abandonment of wells apply to both water wells and other types of wells.	Non-water supply wells will not be constructed on the site unless it can be shown that they will not be a source or cause of groundwater contamination.
Connecticut Water Pollution Control Act - Permitting Regulations	RSCA 22a-430 1-8	Relevant and Appropriate	Establishes permitting requirements for discharges to surface water, groundwater, and POTWs.	If any remedial activities result in any direct discharges to surface water or groundwater, they must comply with the substantive requirements of these regulations. Specific criteria may be established for discharges so that numeric criteria established in the WQSs are not violated.

TABLE 2-26

ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVE GW2-3 - EXTRACTION AND OFF-SITE DISCHARGE
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
State of Connecticut (continued)				
Connecticut Environmental Land Use Restriction Regulations	RCSA 22A-133q-1	Applicable	Requirements to prevent disturbance of contaminated soil and to ensure that contaminated groundwater is not used for human consumption.	Implementation of environmental land use restrictions including deed restrictions.
Connecticut Environmental Land Use Restriction Regulations	RCSA 22A-133q-1	Applicable	Requirements to prevent disturbance of contaminated soil and to ensure that contaminated groundwater is not used for human consumption.	Implementation of environmental land use restrictions including deed restrictions.

TABLE 2-27

ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER ALTERNATIVE GW2-3 – EXTRACTION AND OFF-SITE DISCHARGE OPERABLE UNIT 9 RECORD OF DECISION NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
FEDERAL				
Coastal Zone Management Act	16 USC Parts 1451 et. seq.	Applicable	Requires that any actions must be conducted in a manner consistent with state-approved management programs.	The actions associated with Alternative GW2-3 would comply with the substantive requirements of this act.
Floodplain Management	40 C.F.R. §6.302(b); Appendix A	Applicable	This regulation codifies standards established under Executive Order 11988 and requires action to avoid long- and short-term impacts associated with occupancy and modifications related to floodplain development, wherever there is a practicable alternative. Promotes the preservation and restoration of floodplains so that their natural and beneficial value can be realized.	If there is no practicable alternative to the extraction and discharge remedy within the 100-year floodplain, all practicable means will be taken to limit harm to and preserve beneficial values of floodplains.
Protection of Wetlands	40 C.F.R. §6.302(a); Appendix A	Applicable	This regulation codifies standards established under Executive Order 11990. Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent.	If there is no practicable alternative to implementing the extraction and discharge remedy in a manner that may impact wetlands, measures will be taken to limit impacts.
Clean Water Act Guidelines for Specification of Disposal Sites for Dredged or Fill Material	33 USC §1344; Section 404(b)(1) 40 C.F.R. Parts 230 and 231 and 33 C.F.R. Parts 320 through 323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. This act controls discharges of dredged or fill material to protect aquatic ecosystems.	This alternative includes installation, maintenance and/or operation of the extraction and off-site discharge remedy in or near a wetland. Any remedial activities that will alter wetlands will be conducted in accordance with these standards.

TABLE 2-27

ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER ALTERNATIVE GW2-3 – EXTRACTION AND OFF-SITE DISCHARGE OPERABLE UNIT 9 RECORD OF DECISION NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
STATE OF CONNECTICUT				
Connecticut Coastal Management Act	CGS §22a-444	Applicable	The site is in a coastal zone management area; therefore, requirements for site planning must include approval of activities within the coastal zone to minimize project impacts to this area.	The activities associated with Alternative GW2-3 would comply with the substantive requirements of this act.
Inland Wetland and Watercourses Act and Regulations	CGS 22a-36 through 45; RCSA 22a-39-1 through 15	Applicable	These standards regulate any operation in or affecting an inland wetland or watercourse, involving removal or deposition of material or any obstruction, alteration, or pollution of such wetlands. The standards incorporate local wetland regulations, which include additional substantive requirements and a wetland and watercourse boundary map for the Town of Groton.	If there is no practicable alternative to implementing the extraction and discharge remedy in a manner that may impact designated wetlands or watercourses, measures will be taken to limit impacts.

TABLE 2-28

ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs FOR GROUNDWATER ALTERNATIVE GW3-2 - SELECTED REMEDY OPERABLE UNIT 9 RECORD OF DECISION NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
Federal				
Cancer Slope Factors	Not Applicable	To Be Considered (TBC)	These are guidance values used in risk assessment to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Alternatives would prevent exposure to contaminated groundwater until concentrations have achieved acceptable levels that meet human health concerns.
Reference Doses	Not Applicable	TBC	These are guidance values used in risk assessment to evaluate the potential non-carcinogenic hazard caused by exposure to contaminants.	Alternatives would prevent exposure to contaminated groundwater until concentrations have achieved acceptable levels that meet human health concerns.
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	TBC	Guidance for assessing cancer risk from exposures to pollutants and other agents in the environment. As part of the characterization process, explicit evaluations are made of the hazard and risk potential for susceptible lifestages, including children.	Alternative will meet this standard because potential carcinogenic risks caused by exposure to contaminants will be addressed.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	TBC	Guidance for assessing cancer risks to children. Addresses a number of issues pertaining to cancer risks associated with early-life exposures and also provides specific guidance on potency adjustments for carcinogens acting through the mutagenic mode of action.	Alternative will meet this standard because potential carcinogenic risks caused by exposure to contaminants will be addressed.

TABLE 2-28

ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVE GW3-2 - SELECTED REMEDY
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
State of Connecticut				
Remediation Standard Regulations	CGS 22a-133k; RCSA 22a-133k - 1 through 3	Applicable	This regulation provides specific numerical cleanup criteria for contaminants in groundwater. Requirements are based on groundwater in the area being classified by the state as GB.	Alternatives will meet these standards by restricting access to contaminated GB groundwater through institutional controls (NSB-NLON Site Use Restrictions document for as long as the Navy owns the property) or environmental land use restrictions if the Navy transfers ownership of the property).

TABLE 2-29

ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER ALTERNATIVE GW3-2 - SELECTED REMEDY OPERABLE UNIT 9 RECORD OF DECISION NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT

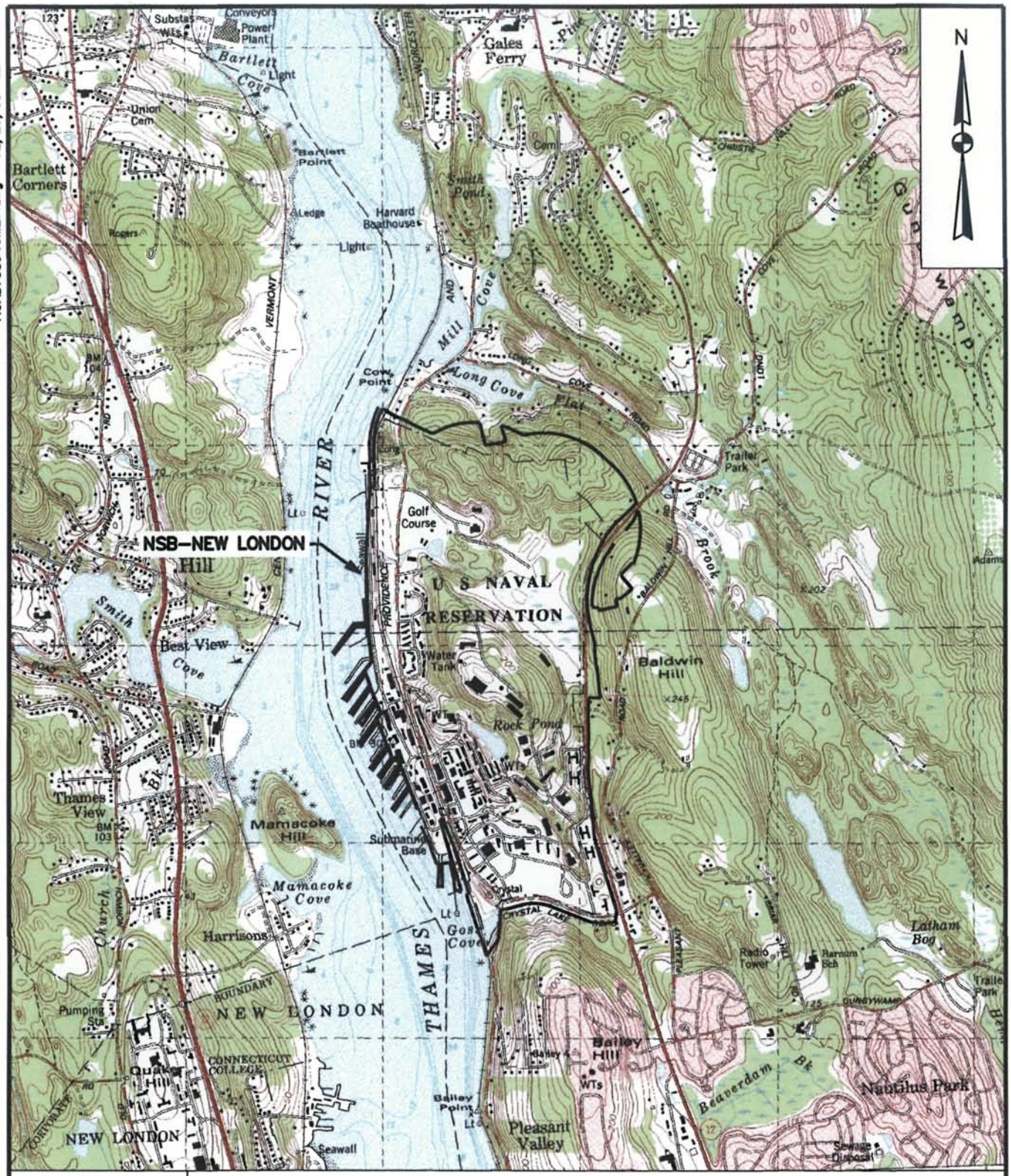
Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
State of Connecticut				
Standards of Water Quality/Water Quality Standards (WQSs) IV	CGS 22a-426 and promulgated standards	Applicable	Standards have been promulgated in accordance with GCS22a-426 of the Connecticut General Statutes to preserve and enhance the quality of state groundwater and surface water. Groundwater at the sites is classified as GB.	These standards for groundwater will be met through monitoring of natural degradation processes. Institutional controls will prevent the aquifer from being used as a water supply until these standards are attained.
Connecticut Regulations for the Well Drilling Industry	RSCA 25-128-33 through 64	Applicable	These rules apply mainly to any new water supply or withdrawal wells. The rules specify that non-water supply wells must be constructed so that they are not a source or cause of groundwater contamination. Procedures for abandonment of wells apply to both water wells and other types of wells.	Non-water supply wells will not be constructed on the site unless it can be shown that they will not be a source or cause of groundwater contamination.
Connecticut Water Pollution Control Act - Permitting Regulations	RSCA 22a-430 1-8	Relevant and Appropriate	Establishes permitting requirements for discharges to surface water, groundwater, and POTWs.	If any remedial activities result in any direct discharges to surface water or groundwater, they must comply with the substantive requirements of these regulations. Specific criteria may be established for discharges so that numeric criteria established in the WQSs are not violated.

TABLE 2-29

ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs FOR GROUNDWATER
ALTERNATIVE GW3-2 - SELECTED REMEDY
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Evaluation/Action to be Taken
State of Connecticut (continued)				
Connecticut Environmental Land Use Restriction Regulations	RCSA 22A-133q-1	Applicable	Requirements to prevent disturbance of contaminated soil and to ensure that contaminated groundwater is not used for human consumption.	Implementation of environmental land use restrictions including deed restrictions.
Connecticut Soil Vapor Remediation Standards Regulations	RCSA 22a-133k-3(c)	Applicable	These standards establish volatilization criteria to address volatile organic substances in groundwater and soil vapor.	For areas where data show the potential for an unacceptable indoor inhalation risk, remedial actions (e.g., sub-slab depressurization systems) will be applied, as needed, to comply with the substantive provisions of these regulations.

ACAD: 0894CM27.dwg 02/29/08 MF PIT



CONNECTICUT

QUADRANGLE LOCATION

0 2000 4000

SCALE IN FEET

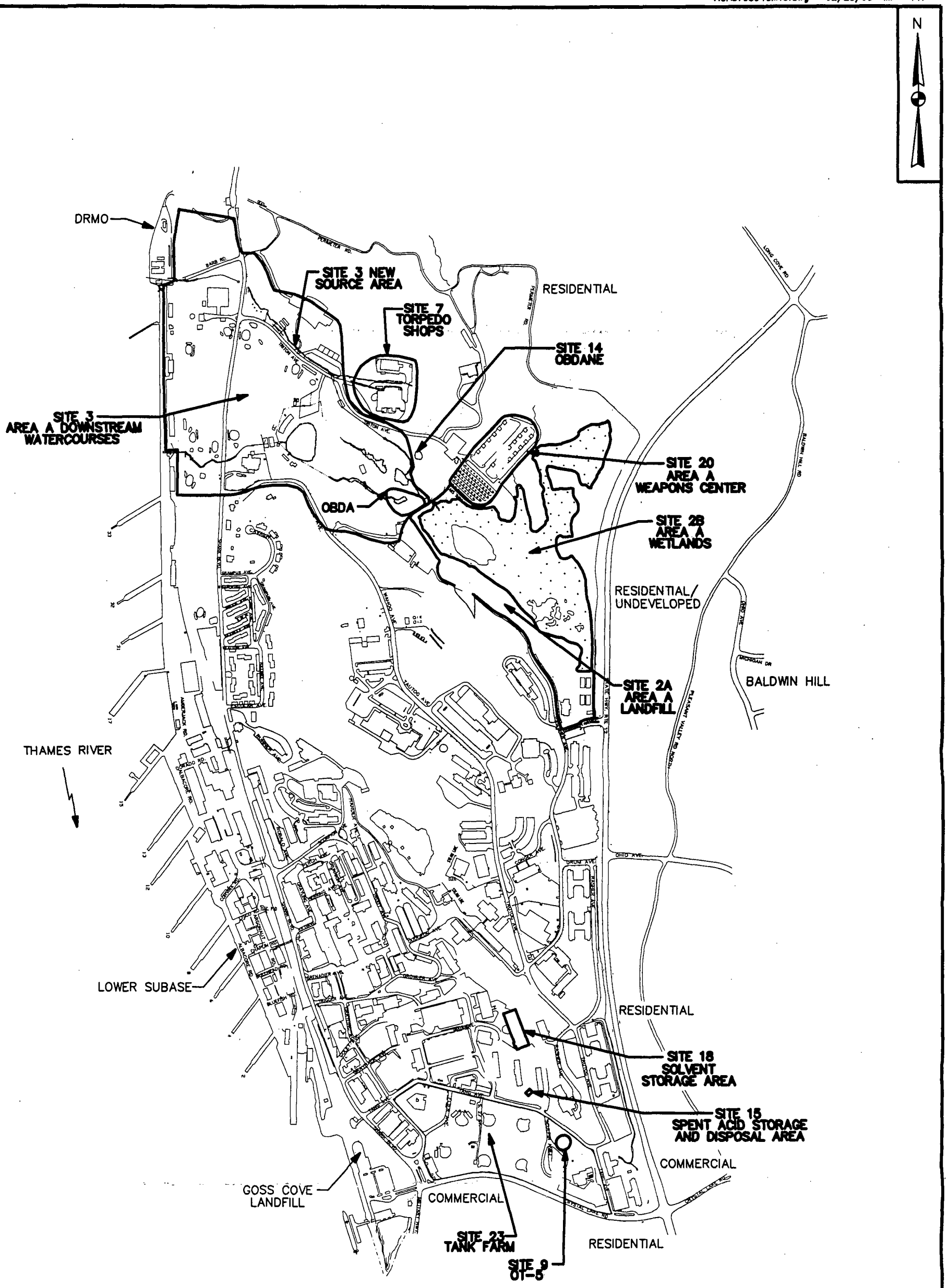
SOURCE: QUADRANGLE MAP UNCASVILLE, CONNECTICUT 1984.

DRAWN BY MF	DATE 2/29/08	Tetra Tech NUS, Inc.	CONTRACT NO. 0894
CHECKED BY	DATE		OWNER NO. 0431
REVISED BY	DATE		APPROVED BY CAL DATE 2/29/08
SCALE AS NOTED			DRAWING NO. FIGURE 2-1 REV. 0

LOCATION MAP
OPERABLE UNIT 9 -
BASEWIDE GROUNDWATER
RECORD OF DECISION
NSB-NLON, GROTON, CONNECTICUT

FORM CADD NO. TTNUS–AV.DWG – REV 1 –9/10/98

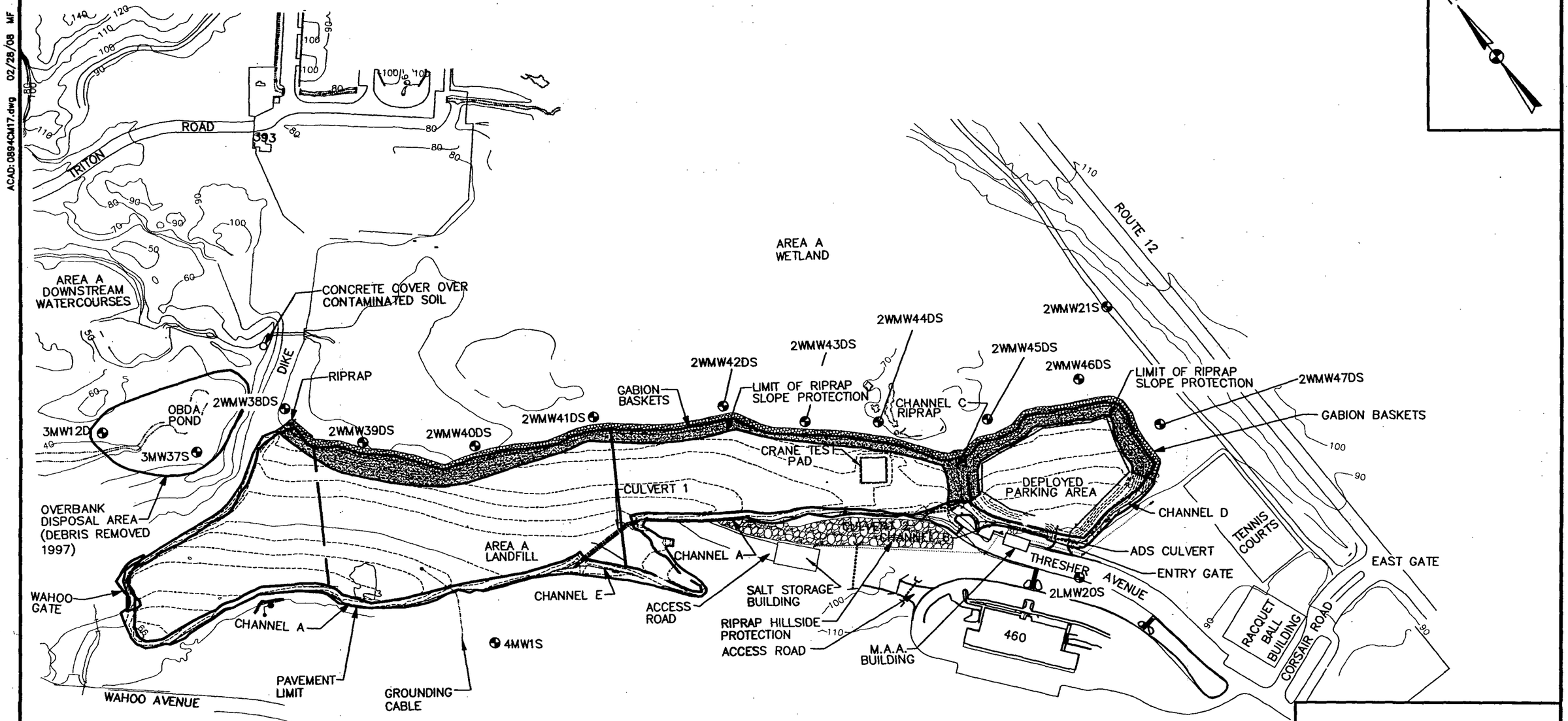
ACAD: 0894CM15.dwg 02/28/08 MF PIT



DRAWN BY MF	DATE 2/28/08	Tetra Tech NUS, Inc.	CONTRACT NO. 0894
CHECKED BY	DATE	SITE LOCATION MAP OPERABLE UNIT 9 - BASEWIDE GROUNDWATER RECORD OF DECISION NSB-NLON, GROTON, CONNECTICUT	OWNER NO. 0431
REVISED BY	DATE		APPROVED BY CAL DATE 2/29/08
SCALE AS NOTED			DRAWING NO. FIGURE 2-2 REV. 0

FORM CADD NO. TTNUS-BV.DWG - REV 1 -9/11/98

ACAD: 0894CM17.dwg 02/28/08 MF PIT



LEGEND:

- MONITORING WELL

0 200 400

GRAPHIC SCALE IN FEET

NOTE:

GROUNDWATER ANALYTICAL DATA FROM MONITORING REPORT FOR AREA A LANDFILL: YEAR 7 (ECC, 2007)

DRAWN BY / DATE	MF 2/28/07
CHECKED BY / DATE	
REVISED BY / DATE	
SCALE	AS NOTED

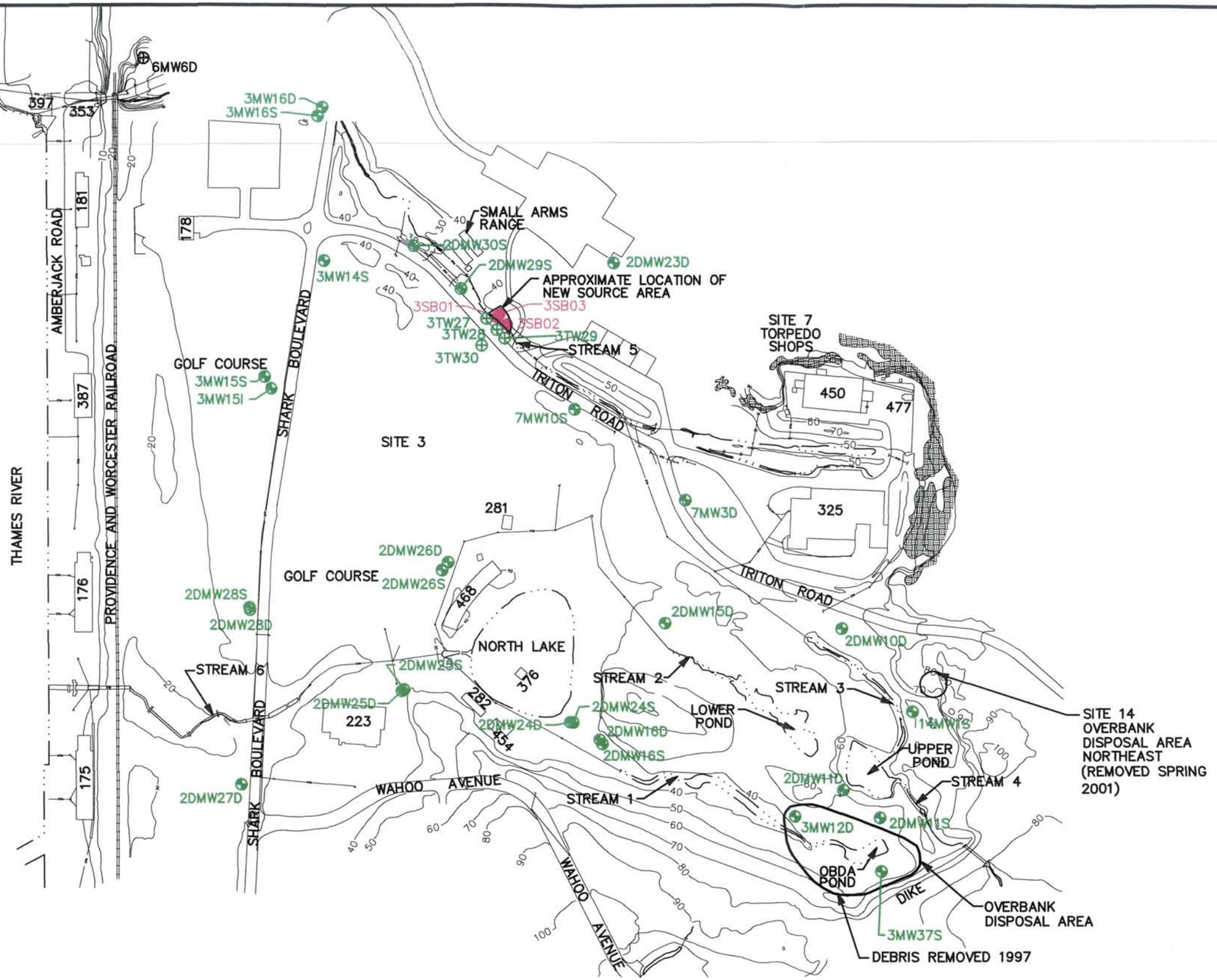
Tetra Tech NUS, Inc.

SITE 2 GENERAL SITE LAYOUT AND SAMPLE LOCATIONS OPERABLE UNIT 9 - BASEWIDE GROUNDWATER NSB-NLON, GROTON, CONNECTICUT

CONTRACT NO.	0894
OWNER NO.	0431
APPROVED BY / DATE	2/29/08
DRAWING NO.	FIGURE 2-3
REV.	0

FORM CADD NO. TTNUS-BH.DWG - REV 1 - 9/10/98

ACAD: 0894CM14.dwg 02/28/08 MF PIT



LEGEND:

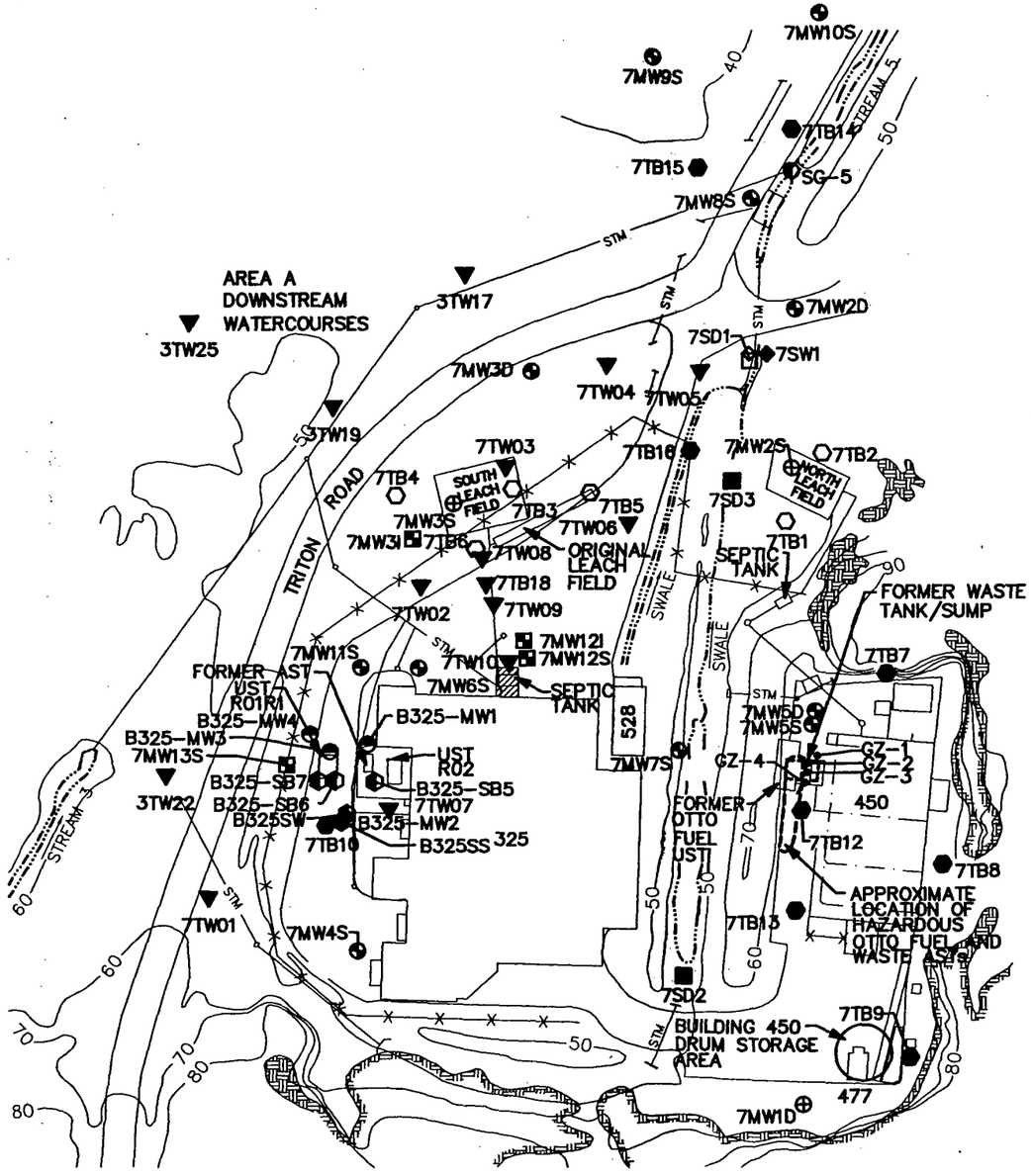
- 3MW14S — PERMANENT MONITORING WELL
- 3TW27 — TEMPORARY MONITORING WELL
- 3SB01 — SOIL BORING
- 10 — TOPOGRAPHIC CONTOUR (BASE 1982)
- 325 — BUILDING No.
- WATERCOURSE
- STM — STORM SEWER AND CATCH BASIN
- EXPOSED BEDROCK

0 260 520
SCALE IN FEET

DRAWN BY MF DATE 2/28/08	Tetra Tech NUS, Inc.	SITES 3 AND 14 GENERAL SITE LAYOUT AND SAMPLING LOCATIONS OPERABLE UNIT 9 - BASEWIDE GROUNDWATER RECORD OF DECISION NSB-NLON, GROTON, CONNECTICUT	CONTRACT NO. 0894
CHECKED BY DATE			OWNER NO. 0431
REVISED BY DATE			APPROVED BY DATE 2/29/08
SCALE AS NOTED			DRAWING NO. FIGURE 2-4 REV. 0

FORM CADD NO. TTNUS-BH.DWG – REV 1 – 9/10/98

ACAD: 0894CM23.dwg 02/29/08 MF PIT



N

NOTES

1. UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE.
2. BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB--NLON AND PHASE II RI WORK PLAN.

LEGEND

7MW13S	GROUNDWATER MONITORING PROGRAM WELL
7MW2S	PHASE I MONITORING WELL
7MW7S	PHASE II MONITORING WELL
B325-MW1	SITE CHARACTERIZATION MONITORING WELL
7TB1	PHASE I TEST BORING
7TB12	PHASE II TEST BORING
B325-SB6	SITE CHARACTERIZATION SOIL BORING
7SW1	PHASE I EXISTING SURFACE WATER SAMPLE
7SW1	PHASE II SURFACE WATER SAMPLE
7SD1	PHASE I SEDIMENT SAMPLE
7SD3	PHASE II SEDIMENT SAMPLE
SG-5	PHASE II STAFF GAUGE
7TB17	BGOURI TEST BORING LOCATION
7TW17	BGOURI TEMPORARY WELL
10	TOPOGRAPHIC CONTOUR
123	BUILDING No.
	WATERCOURSE
STM	STORM SEWER AND CATCH BASIN
	EXPOSED BEDROCK
	FENCE

0 110 220
SCALE IN FEET

DRAWN BY MF	DATE 2/29/08	Tetra Tech NUS, Inc.	SITE 7 GENERAL SITE LAYOUT AND SAMPLING LOCATIONS OPERABLE UNIT 9 - BASEWIDE GROUNDWATER RECORD OF DECISION NSB-NLON, GROTON, CONNECTICUT
CHECKED BY	DATE		
REVISED BY	DATE		
SCALE AS NOTED			

CONTRACT NO. 0894	
OWNER NO. 0431	
APPROVED BY CAM	DATE 2/29/08
DRAWING NO. FIGURE 2-5	REV. 0

FORM CADD NO. TTNUS-BH.DWG - REV 1 - 9/10/98

ACAD: 0894CM28.DWG 02/29/08 MF PIT

SITE 9

OT-MW04
OT-MW03
OT-MW02
O.T.5
OT-MW01

SITE 9 (SEE INSET)

SITE 15

SITE 23

23MW03D
15MW2S
15MW1S
15MW1D
15MW3S
23MW04D
23MW04S
23MW02D
23MW02S
23MW01S
23MW01D
HNUS-5
HNUS-2
HNUS-20
HNUS-23
HNUS-11
HNUS-13
8MW1
8MW2D
8MW2S
8MW3
8MW4
8MW5S
8MW6D
8MW6S
8MW7S (DESTROYED)
8MW8D
8MW8S
8MW9S
8MW10S
O.T.1
O.T.2
O.T.3
O.T.4
O.T.5
O.T.7
O.T.8
O.T.9
O.T.12
O.T.13
TANK AVE.
GOLET AVE.
GRAYBACK AVE.
SHARK BLVD.
BASHER AVE.
TAUTOG AVE.
ROUTE 12
JOGGING TRACK
METERING PIT/MANHOLE
MAIN GATE
JUNCTION BOX
SEWER PUMP STA.
MILITARY HWY.
CRYSTAL LAKE RD
NAUTILUS MEMORIAL

LEGEND

- MONITORING WELL
- TANK UNDERDRAIN PIPES
- UNDERDRAIN PIPES RELINED IN 2000
- STORMWATER SYSTEM INSTALLED IN 2000
- FORMER OIL TANKS
- PREVIOUSLY EXISTING STORMWATER SYSTEM

0 200 400
GRAPHIC SCALE IN FEET

0 80 160
GRAPHIC SCALE IN FEET

DRAWN BY MF	DATE 2/29/08
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	

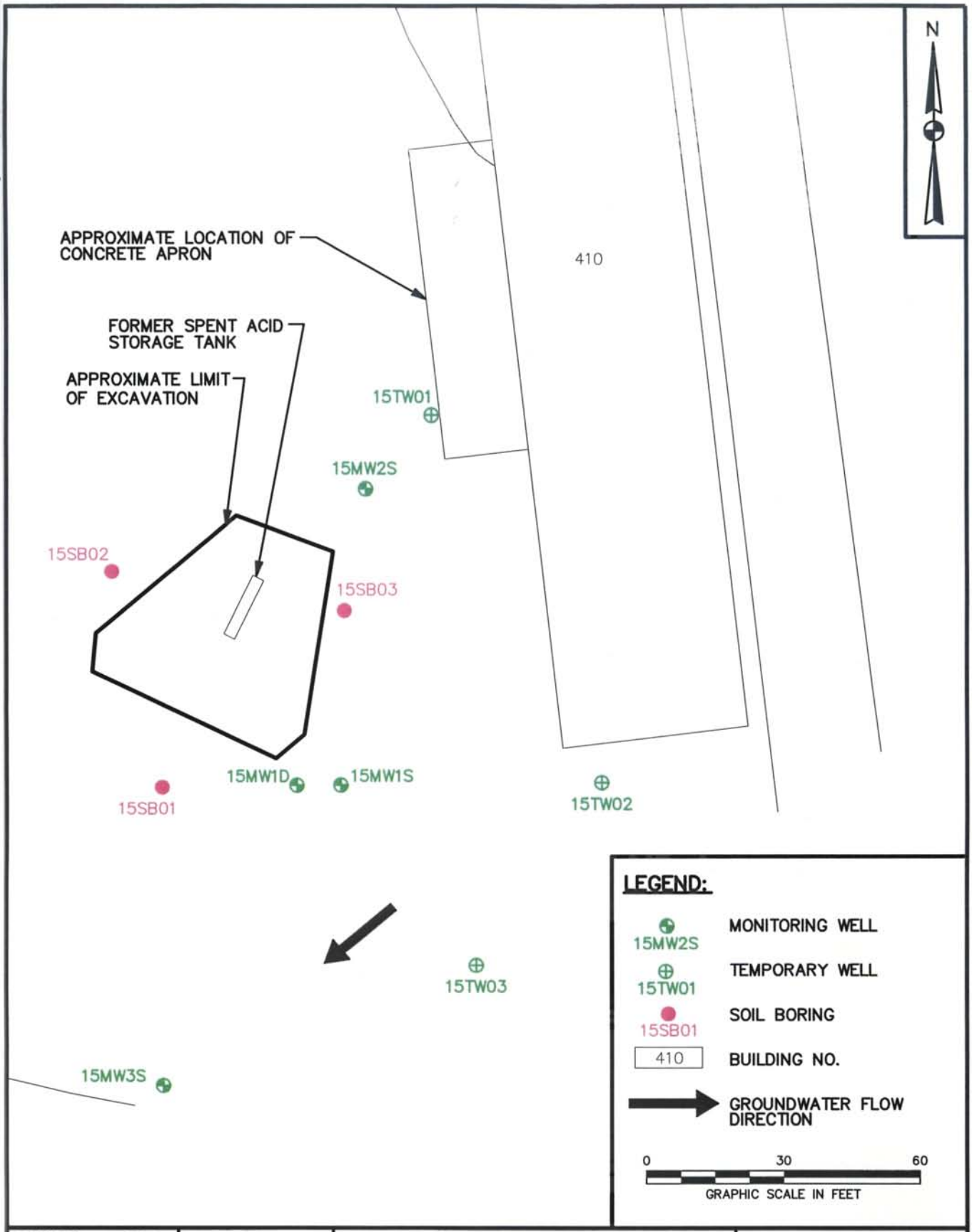
Tetra Tech NUS, Inc.

SITES 9 & 23
GENERAL SITE LAYOUT
OPERABLE UNIT 9 –
BASEWIDE GROUNDWATER
NSB–NLON, GROTON, CONNECTICUT

CONTRACT NO. 0894	
OWNER NO. 0431	
APPROVED BY	DATE
DRAWING NO. FIGURE 2–6	REV. 0

FORM CADD NO. TTNUS-BH.DWG - REV 1 - 9/10/98

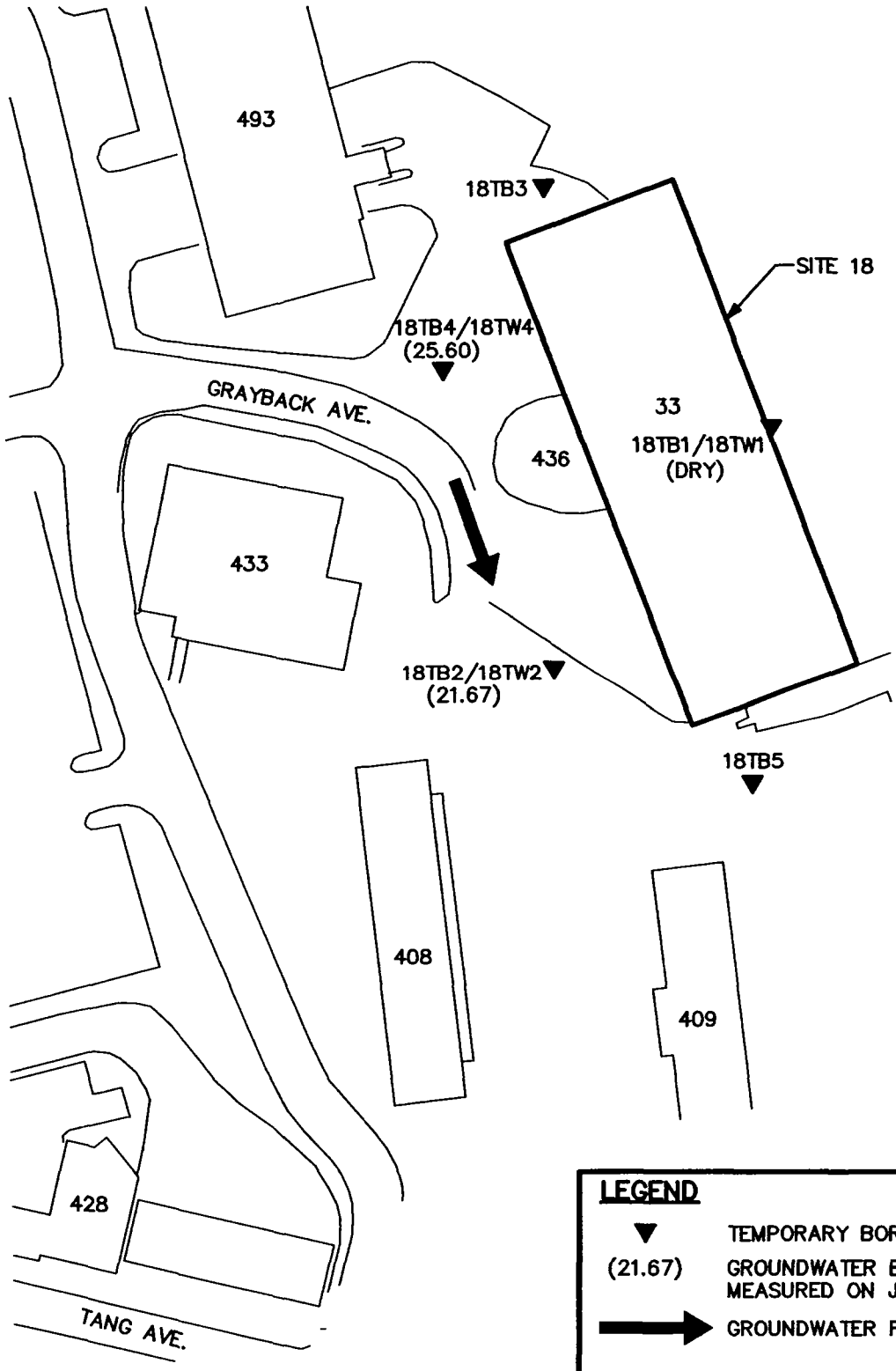
ACAD: 0894CM11.dwg 02/28/08 MF PIT



DRAWN BY MF DATE 2/28//07	Tetra Tech NUS, Inc.	SITE 15 GENERAL LAYOUT AND SAMPLING LOCATIONS OPERABLE UNIT 9 - BASEWIDE GROUNDWATER NSB-NLON, GROTON, CONNECTICUT	CONTRACT NO. 0894
CHECKED BY DATE			OWNER NO. 0431
REVISED BY DATE			APPROVED BY CAL DATE 2/29/08
SCALE AS NOTED			DRAWING NO. FIGURE 2-7 REV. 0

FORM CADD NO. TTNUS-AV.DWG – REV 1 –9/10/98

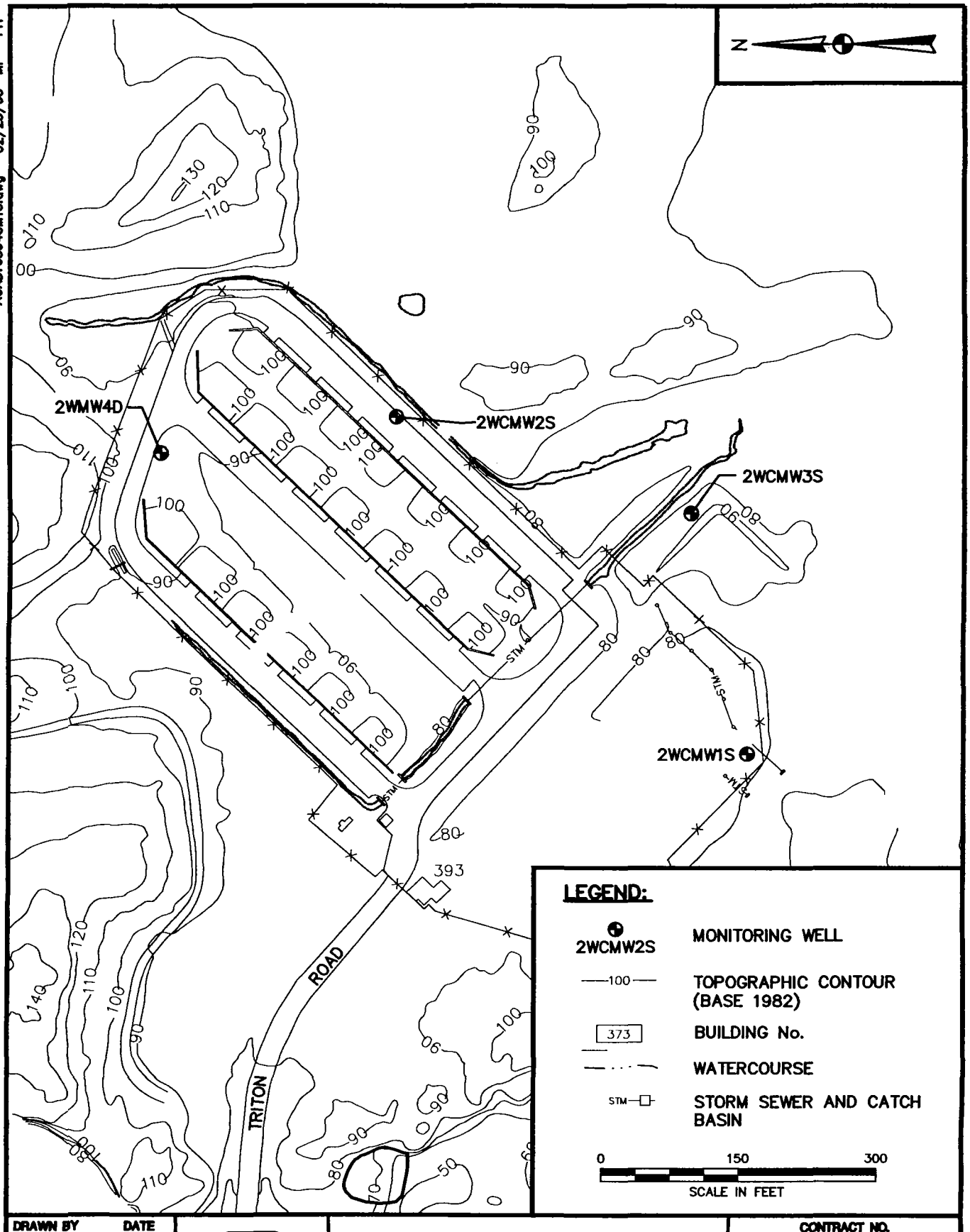
ACAD: 0894CM12.dwg 02/28/08 MF PIT



DRAWN BY MF DATE 2/28/08	Tetra Tech NUS, Inc.	SITE 18 GENERAL LAYOUT AND SAMPLING LOCATIONS OPERABLE UNIT 9 - BASEWIDE GROUNDWATER NSB-NLON, GROTON, CONNECTICUT	CONTRACT NO. 0894
CHECKED BY DATE			OWNER NO. 0431
REVISED BY DATE			APPROVED BY CAR DATE 2/29/08
SCALE AS NOTED			DRAWING NO. FIGURE 2-8 REV. 0

FORM CADD NO. TTNUS-AV.DWG - REV 1 -9/10/98

ACAD: 0894CM13.dwg 02/28/08 MF PIT

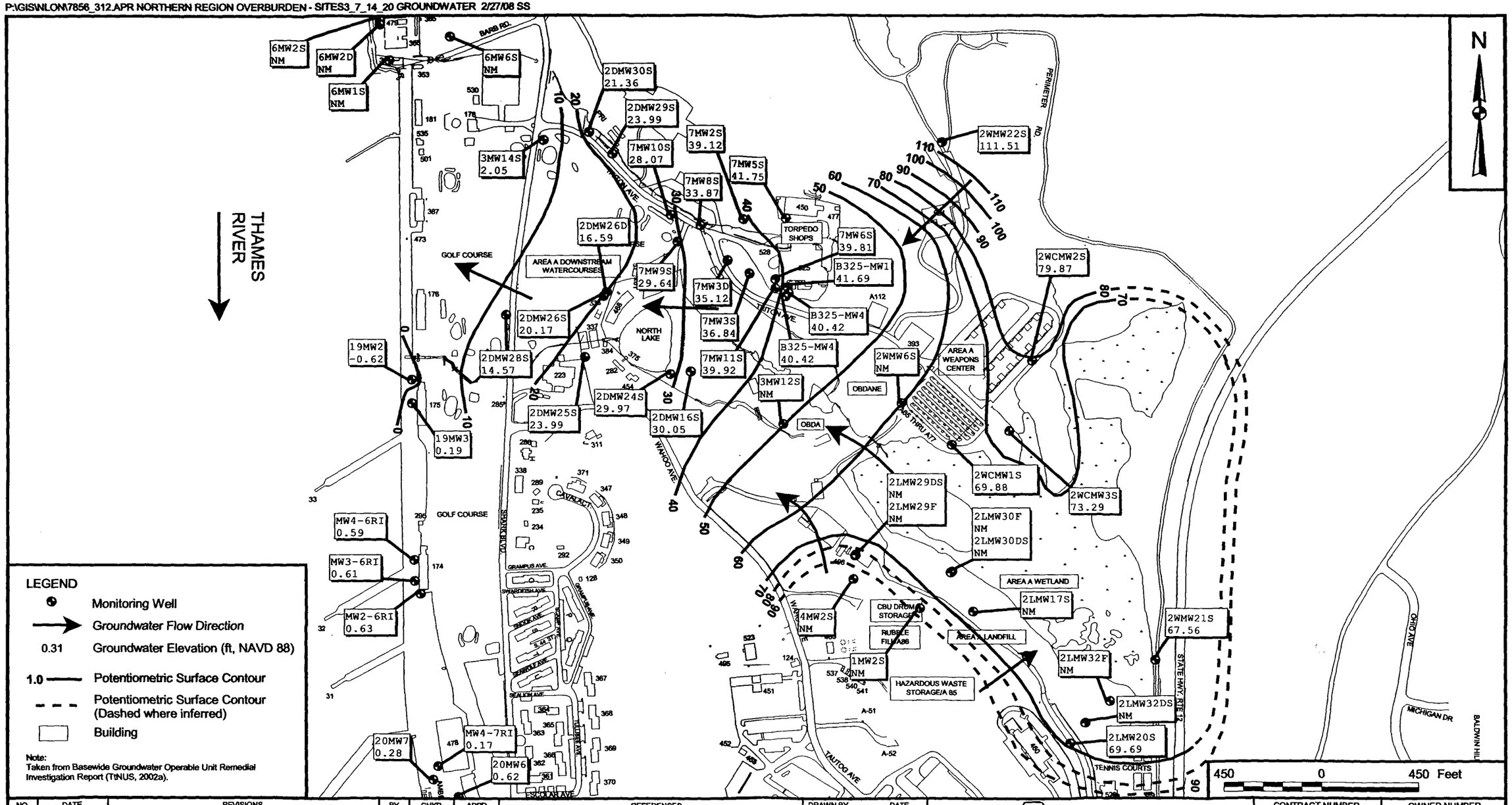


DRAWN BY: MF	DATE: 2/28/08	Tetra Tech NUS, Inc.	SITE 20 GENERAL SITE LAYOUT AND SAMPLING LOCATIONS OPERABLE UNIT 9 - BASEWIDE GROUNDWATER RECORD OF DECISION NSB-NLON, GROTON, CONNECTICUT
CHECKED BY:	DATE:		
REVISED BY:	DATE:		
SCALE: AS NOTED			

CONTRACT NO.	0894
OWNER NO.	0431
APPROVED BY: CAR	DATE: 2/29/08
DRAWING NO.	FIGURE 2-9
REV.	0

FORM CADD NO. TTNUS-AV.DWG - REV 1 -9/10/98

P:\GIS\NLON\7856_312.APR NORTHERN REGION OVERBURDEN - SITES3_7_14_20 GROUNDWATER 2/27/08 SS



LEGEND

- Monitoring Well
- Groundwater Flow Direction
- 0.31 Groundwater Elevation (ft, NAVD 88)
- 1.0 Potentiometric Surface Contour
- Potentiometric Surface Contour (Dashed where inferred)
- Building

Note:
Taken from Basewide Groundwater Operable Unit Remedial Investigation Report (TtNUS, 2002a).

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DATE

CHECKED BY DATE

COST/SCHEDULE-AREA

SCALE
AS NOTED

Tetra Tech NUS, Inc.

SHALLOW OVERBURDEN POTENTIOMETRIC SURFACE MAP
AUGUST 2000
NORTHERN REGION
OPERABLE UNIT 9 - BASEWIDE GROUNDWATER
RECORD OF DECISION
NSB-NLON, GROTON, CONNECTICUT

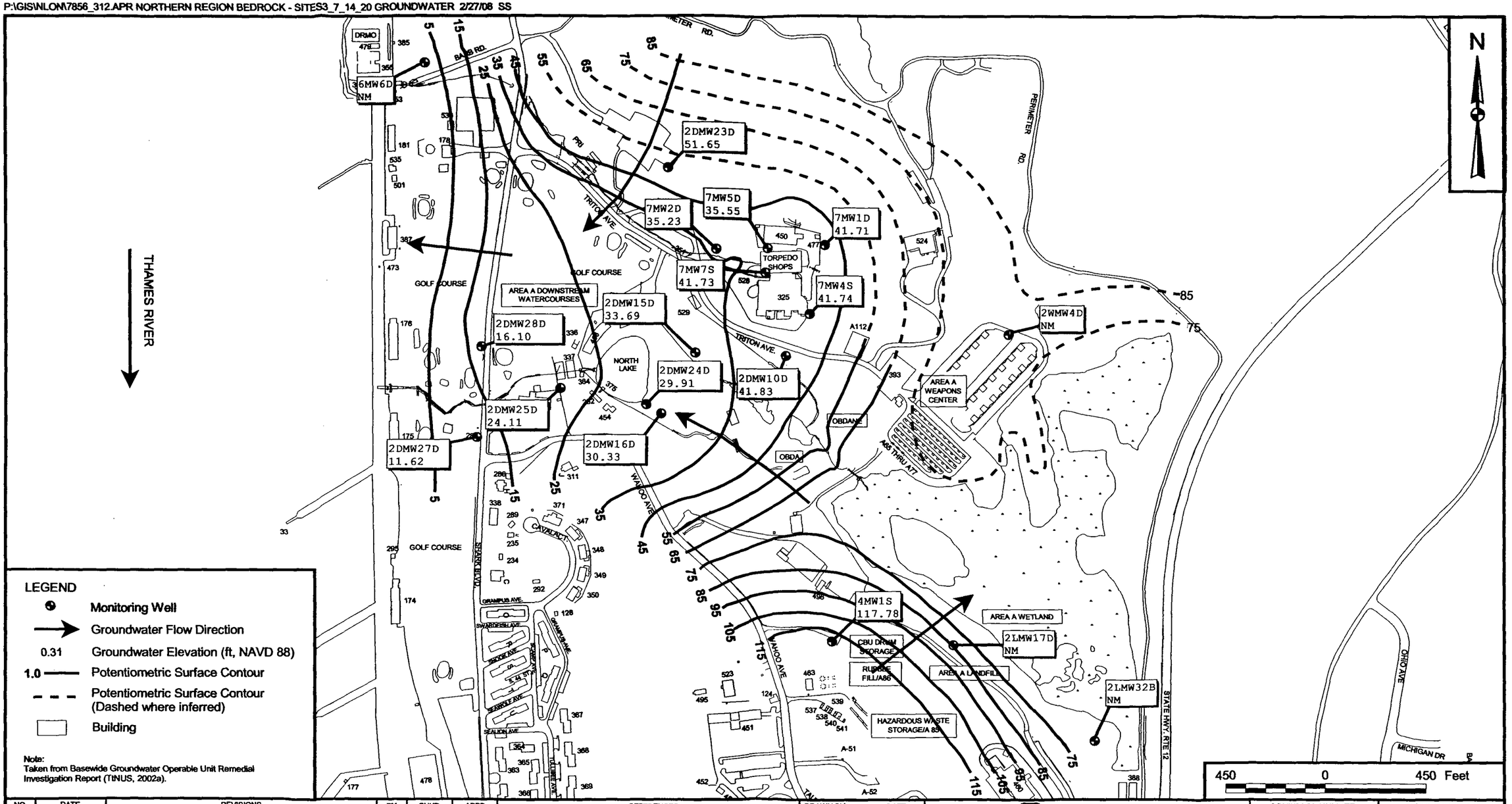
CONTRACT NUMBER 0894 | OWNER NUMBER 0431

APPROVED BY [signature] DATE 2/29/08

APPROVED BY — DATE —

DRAWING NO. FIGURE 2-10 | REV 0

P:\GIS\NLON\7856_312.APR NORTHERN REGION BEDROCK - SITES3_7_14_20 GROUNDWATER 2/27/08 SS



LEGEND

- Monitoring Well
- Groundwater Flow Direction
- 0.31 Groundwater Elevation (ft, NAVD 88)
- 1.0 Potentiometric Surface Contour
- Potentiometric Surface Contour (Dashed where inferred)
- Building

Note:
Taken from Basewide Groundwater Operable Unit Remedial Investigation Report (TtNUS, 2002a).

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DATE

CHECKED BY DATE

COST/SCHEDULE-AREA

SCALE
AS NOTED

Tetra Tech NUS, Inc.

BEDROCK POTENTIOMETRIC SURFACE MAP
AUGUST 2000
NORTHERN REGION
OPERABLE UNIT 9 - BASEWIDE GROUNDWATER
RECORD OF DECISION
NSB-NLON, GROTON, CONNECTICUT

CONTRACT NUMBER 0894

OWNER NUMBER 0431

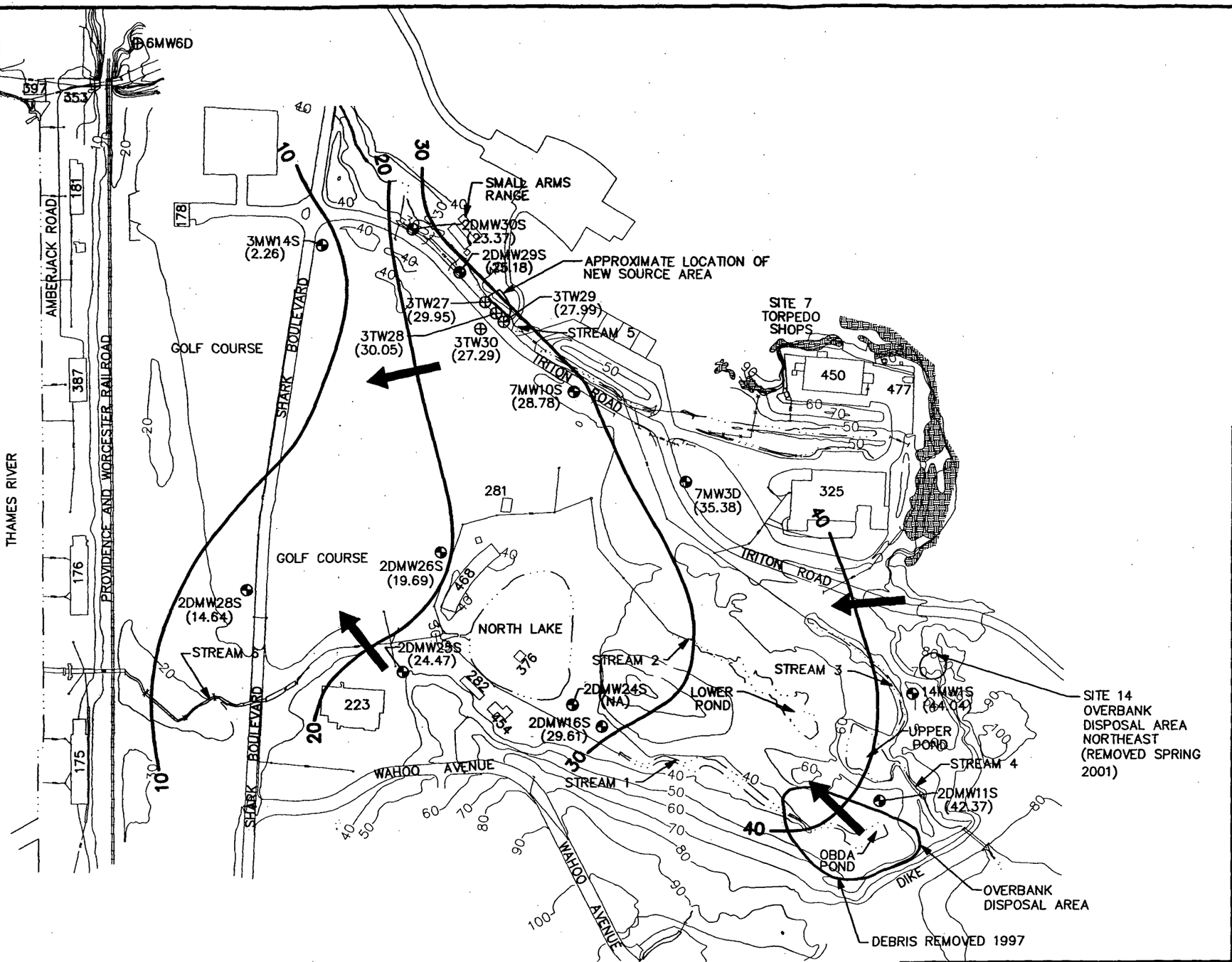
APPROVED BY CAM DATE 2/29/08

APPROVED BY — DATE —

DRAWING NO. FIGURE 2-11

REV 0

ACAD: 0894CA116.dwg 02/29/08 MF PIT



LEGEND:

- 2DMW30S — PERMANENT MONITORING WELL
- 3TW27 — TEMPORARY MONITORING WELL
- 40 — POTENTIOMETRIC SURFACE CONTOUR OCTOBER 2002
- (42.37) — GROUNDWATER ELEVATION (FT.) MEASURED 10-24-02 (VERTICAL DATUM IS NAVD 88)
- GROUNDWATER FLOW DIRECTION
- —10— TOPOGRAPHIC CONTOUR
- 123 — BUILDING No.
- WATERCOURSE
- STM — STORM SEWER AND CATCH BASIN
- EXPOSED BEDROCK

NOTE:

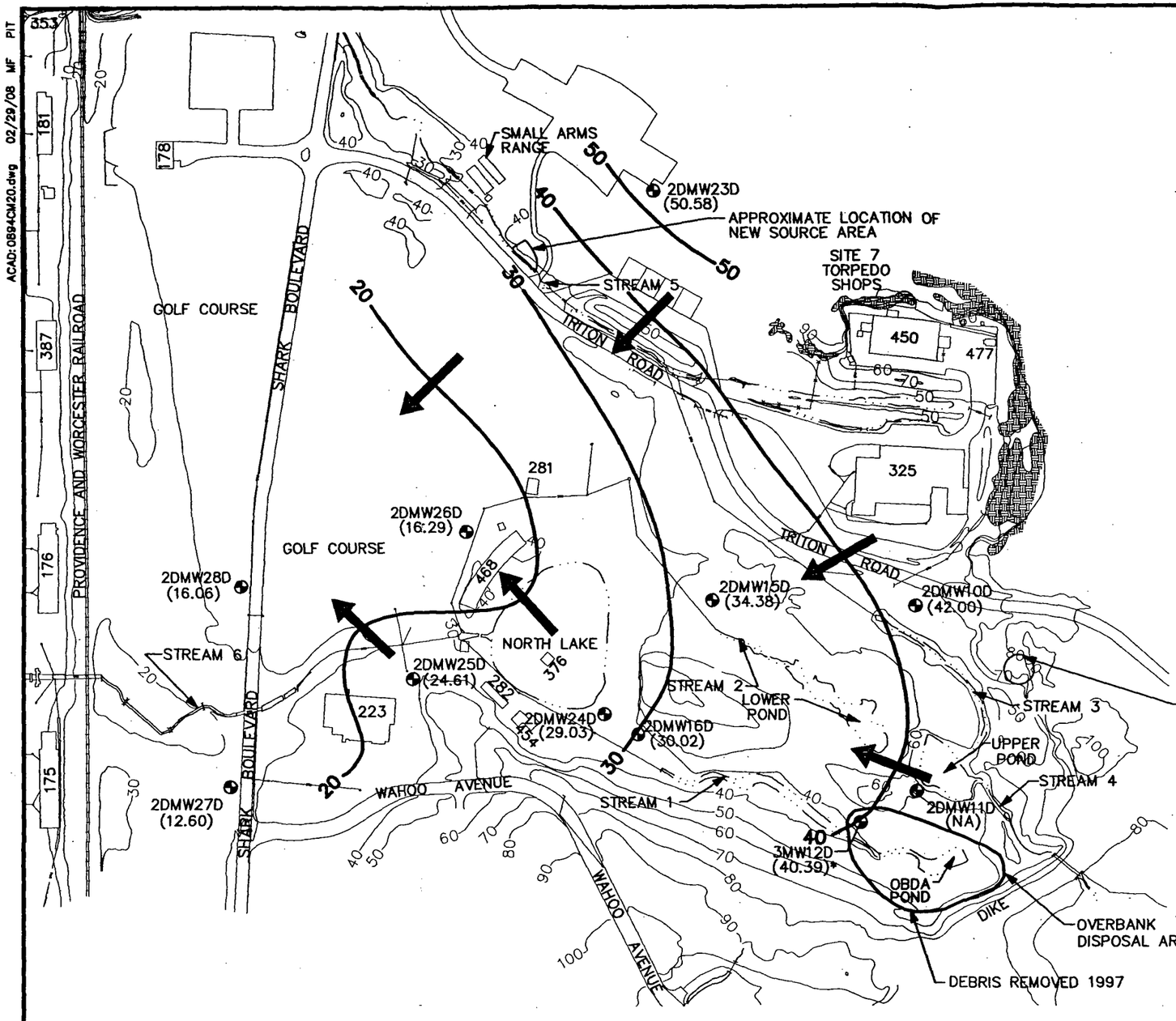
TAKEN FROM BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION UPDATE/FEASIBILITY STUDY (TtNUS, 2004).

0 250 500
SCALE IN FEET

DRAWN BY MF DATE 2/29/08	Tetra Tech NUS, Inc.	SHALLOW OVERBURDEN POTENTIOMETRIC SURFACE MAP FOR SITES 3 AND 14 - OCTOBER 2002 OPERABLE UNIT 9 - BASEWIDE GROUNDWATER RECORD OF DECISION NSB-NLON, GROTON, CONNECTICUT	CONTRACT NO. 0894
CHECKED BY DATE			OWNER NO. 0431
REVISED BY DATE			APPROVED BY CAL DATE 2/29/08
SCALE AS NOTED			DRAWING NO. FIGURE 2-12 REV. 0

FORM CADD NO. TTNUS-BH.DWG - REV 1 - 9/10/98

ACAD:0894CM20.dwg 02/29/08 MF PIT



LEGEND:

- 2DMW23D — PERMANENT MONITORING WELL
- 20 —— POTENTIOMETRIC SURFACE CONTOUR OCTOBER 2002
- (30.02) GROUNDWATER ELEVATION (FT.) MEASURED 10-24-02 (VERTICAL DATUM IS NAVD 88)
- GROUNDWATER FLOW DIRECTION
- —10— TOPOGRAPHIC CONTOUR
- 123 BUILDING No.
- WATERCOURSE
- —STM—□ STORM SEWER AND CATCH BASIN
- EXPOSED BEDROCK

NOTES:

1. * GROUNDWATER MONITORING WELL 3MW12D INSTALLED 10/24/02. GROUNDWATER ELEVATION MEASURED 12/04/02.
2. TAKEN FROM BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION UPDATE/FEASIBILTY STUDY (TtNUS, 2004).

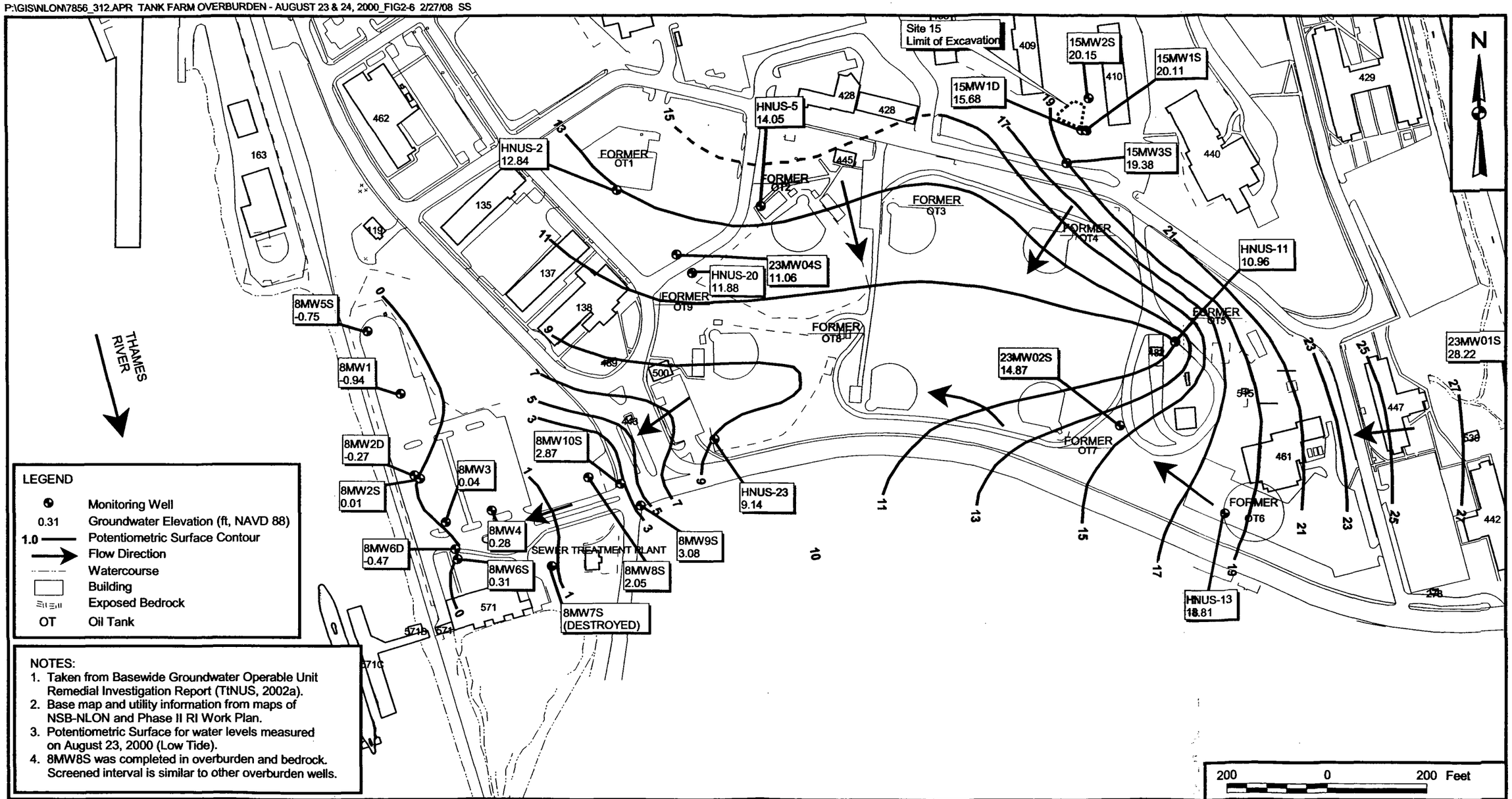
0 250 500
SCALE IN FEET

DRAWN BY MF	DATE 2/29/08	Tetra Tech NUS, Inc.	BEDROCK POTENTIOMETRIC SURFACE MAP FOR SITES 3 AND 14 - OCTOBER 2002 OPERABLE UNIT 9 - BASEWIDE GROUNDWATER RECORD OF DECISION NSB-NLON, GROTON, CONNECTICUT
CHECKED BY	DATE		
REVISED BY	DATE		
SCALE AS NOTED			

CONTRACT NO. 0894	
OWNER NO. 0431	
APPROVED BY CAR	DATE 2/29/08
DRAWING NO. FIGURE 2-13	REV. 0

FORM CADD NO. TTNUS-BH.DWG - REV 1 - 9/10/98

P:\GIS\NLON\7856_312.APR TANK FARM OVERBURDEN - AUGUST 23 & 24, 2000_FIG2-6 2/27/08 SS



LEGEND

- Monitoring Well
- 0.31 Groundwater Elevation (ft, NAVD 88)
- 1.0 Potentiometric Surface Contour
- Flow Direction
- Watercourse
- Building
- Exposed Bedrock
- OT Oil Tank

NOTES:

1. Taken from Basewide Groundwater Operable Unit Remedial Investigation Report (TtNUS, 2002a).
2. Base map and utility information from maps of NSB-NLON and Phase II RI Work Plan.
3. Potentiometric Surface for water levels measured on August 23, 2000 (Low Tide).
4. 8MW8S was completed in overburden and bedrock. Screened interval is similar to other overburden wells.

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DATE

CHECKED BY DATE

COST/SCHEDULE-AREA

SCALE
AS NOTED

Tetra Tech NUS, Inc.

SHALLOW OVERBURDEN POTENTIOMETRIC SURFACE MAP
AUGUST 2000
SOUTHERN REGION
OPERABLE UNIT 9 - BASEWIDE GROUNDWATER
RECORD OF DECISION
NSB-NLON, GROTON, CONNECTICUT

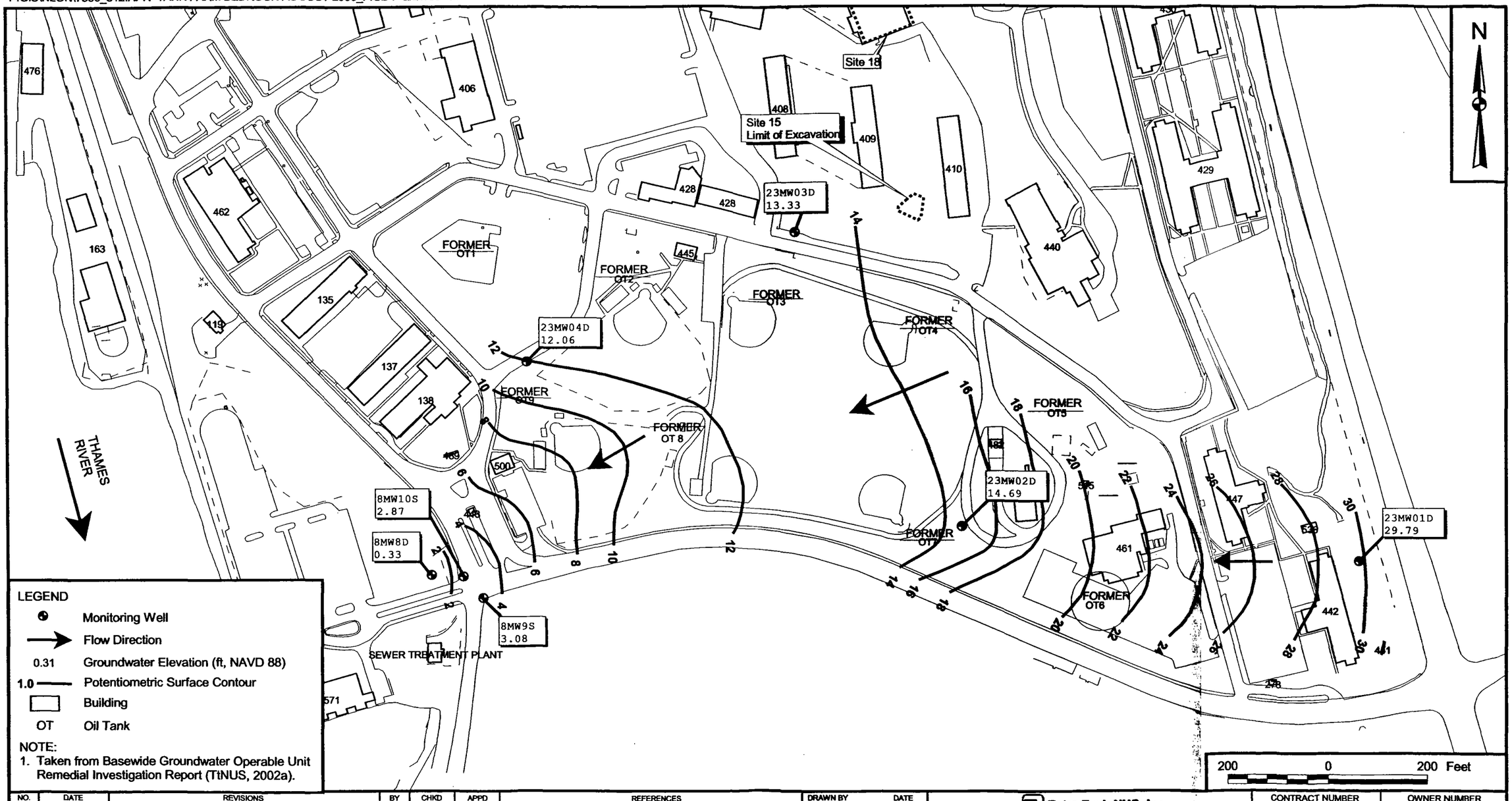
CONTRACT NUMBER 0694 | OWNER NUMBER 0431

APPROVED BY CAL DATE 2/29/08

APPROVED BY — DATE —

DRAWING NO. FIGURE 2-14 | REV 0

P:GIS\NLON\7856_312.APR TANK FARM BEDROCK-AUGUST 2000_FIG2-7 2/27/08 SS



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY / DATE	
CHECKED BY / DATE	
COST/SCHEDULE-AREA	
SCALE	AS NOTED

Tetra Tech NUS, Inc.

BEDROCK POTENTIOMETRIC SURFACE MAP
AUGUST 2000
SOUTHERN REGION
OPERABLE UNIT 9 - BASEWIDE GROUNDWATER
RECORD OF DECISION
NSB-NLON, GROTON, CONNECTICUT

CONTRACT NUMBER 0894	OWNER NUMBER 0431
APPROVED BY CAR	DATE 2/29/08
APPROVED BY —	DATE —
DRAWING NO. FIGURE 2-15	REV 0

ACAD:08904CM21.dwg 02/29/08 MF PIT

PAVEMENT

410

30

PAVEMENT

409

18.8

15TW02 (18.72)

18.8

15TW01 (18.78)

15TW03 (18.64)

18.6

18.4

18.2

18.0

15MW2S (18.69)

15MW1S (18.67)

15MW1D (15.42)

15MW3S (18.06)

FORMER SPENT ACID STORAGE TANK

APPROXIMATE LIMIT OF EXCAVATION

TANG AVENUE

LEGEND:

15MW2S PERMANENT MONITORING WELL

15TW01 TEMPORARY WELL

18.6 POTENTIOMETRIC SURFACE CONTOUR OCTOBER 2002

(18.67) GROUNDWATER ELEVATION (FT.) MEASURED 10-24-02 (VERTICAL DATUM IS NAVD 88)

GROUNDWATER FLOW DIRECTION

NOTE:

TAKEN FROM BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION UPDATE/FEASIBILITY STUDY (TtNUS, 2004)

0 30 60

SCALE IN FEET

DRAWN BY MF DATE 2/29/08	Tetra Tech NUS, Inc.	SITE 15 SHALLOW OVERBURDEN POTENTIOMETRIC SURFACE MAP OPERABLE UNIT 9 - BASEWIDE GROUNDWATER RECORD OF DECISION NSB-NLON, GROTON, CONNECTICUT	CONTRACT NO. 0894
CHECKED BY DATE			OWNER NO. 0431
REVISED BY DATE			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2-16 REV. 0

FORM CADD NO. TTNUS-BH.DWG - REV 1 - 9/10/98

ACAD: 0894CM22.dwg 02/29/08 MF PIT

N

2WMW4D (84.16)

2WCMW2S (79.20)

2WCMW3S (73.53)

2WCMW1S (69.43)

AREA A WETLAND

DEPLOYED PARKING

CRANE TEST PAD

APPROXIMATE LIMIT OF FINAL COVER SYSTEM

TRITON ROAD

DIKE

SITE 14 OBDANE

524

393

573

LEGEND:

- 2WCMW2S — PERMANENT MONITORING WELL
- 70 — POTENTIOMETRIC SURFACE CONTOUR OCTOBER 2002
- (79.20) — GROUNDWATER ELEVATION (FT.) MEASURED 10-24-02 (VERTICAL DATUM IS NAVD 88)
- GROUNDWATER FLOW DIRECTION

NOTE:

TAKEN FROM BASEWIDE GROUNDWATER OPERABLE UNIT REMEDIAL INVESTIGATION UPDATE/FEASIBILITY STUDY (TtNUS, 2004)

0 200 400

SCALE IN FEET

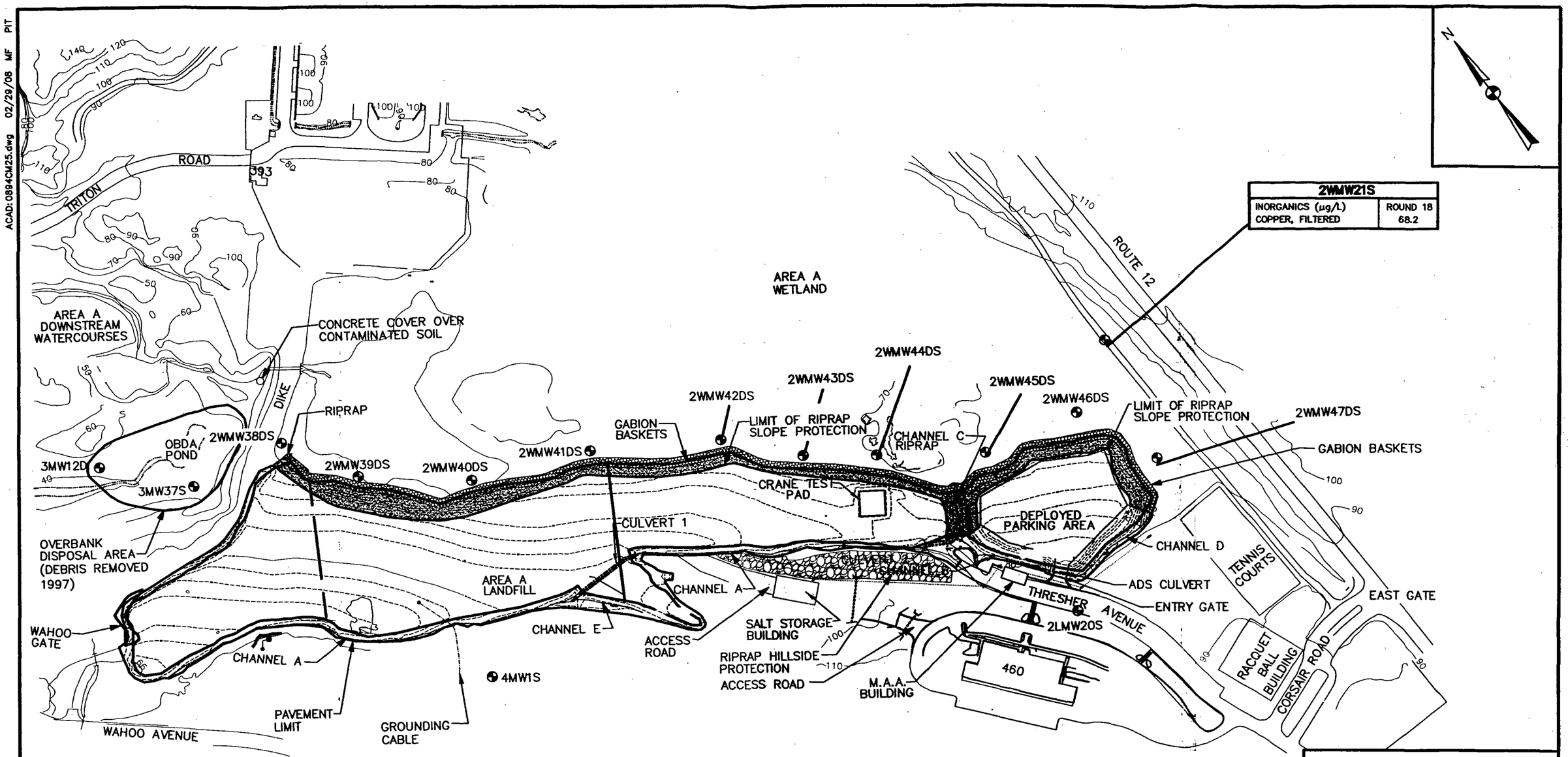
DRAWN BY / DATE	MF 2/29/08
CHECKED BY / DATE	
REVISED BY / DATE	
SCALE	AS NOTED

Tetra Tech NUS, Inc.

SITE 20 SHALLOW OVERBURDEN POTENTIOMETRIC SURFACE MAP
OPERABLE UNIT 9 - BASEWIDE GROUNDWATER RECORD OF DECISION
NSB-NLON, GROTON, CONNECTICUT

CONTRACT NO.	0694
OWNER NO.	0431
APPROVED BY / DATE	CAL 2/29/08
DRAWING NO.	FIGURE 2-17
REV.	0

ACAD: 0894CM25.dwg 02/29/08 MF PIT



LEGEND:

- MONITORING WELL

0 200 400

GRAPHIC SCALE IN FEET

NOTE:

GROUNDWATER ANALYTICAL DATA FROM MONITORING REPORT FOR AREA A LANDFILL: YEAR 7 (ECC, 2007)

DRAWN BY: MF	DATE: 2/29/08
CHECKED BY:	DATE:
REVISED BY:	DATE:
SCALE: AS NOTED	

Tetra Tech NUS, Inc.

SITE 2 YEAR 7 GROUNDWATER MONITORING EXCEEDANCES OPERABLE UNIT 9 - BASEWIDE GROUNDWATER NSB-NLON, GROTON, CONNECTICUT

CONTRACT NO.	0894
OWNER NO.	0431
APPROVED BY / DATE	CAR 2/29/08
DRAWING NO.	FIGURE 2-18
REV.	0

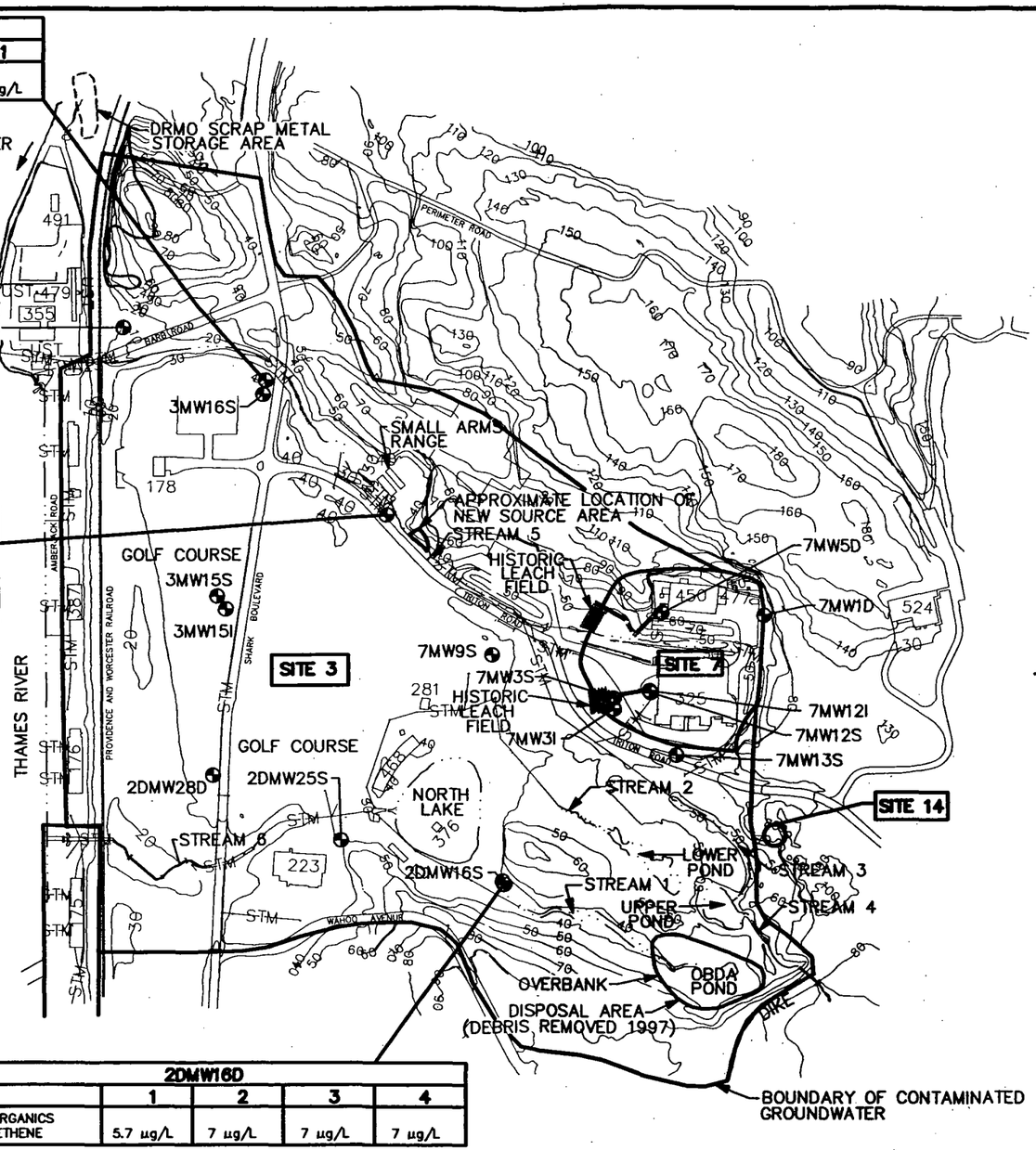
FORM CADD NO. TTNUS-BH.DWG - REV 1 - 9/10/98

ACAD: TTNUS-BH.dwg 08/28/98 INL

3MW16D	
ROUND	1
VOLATILE ORGANICS TRICHLOROETHENE	5.1 µg/L

2DMW29S		
ROUND	2	4
VOLATILE ORGANICS VINYL CHLORIDE	9 µg/L	4 µg/L
2DMW29S DUP		
ROUND	2	4
VOLATILE ORGANICS VINYL CHLORIDE	10 µg/L	NA

2DMW16D				
ROUND	1	2	3	4
VOLATILE ORGANICS TRICHLOROETHENE	5.7 µg/L	7 µg/L	7 µg/L	7 µg/L



N

LEGEND:

NA NOT ANALYZED

MONITORING WELL

0 400 800

SCALE IN FEET

DRAWN BY / DATE	MF 2/29/08
CHECKED BY / DATE	
REVISED BY / DATE	
SCALE	AS NOTED

Tetra Tech NUS, Inc.

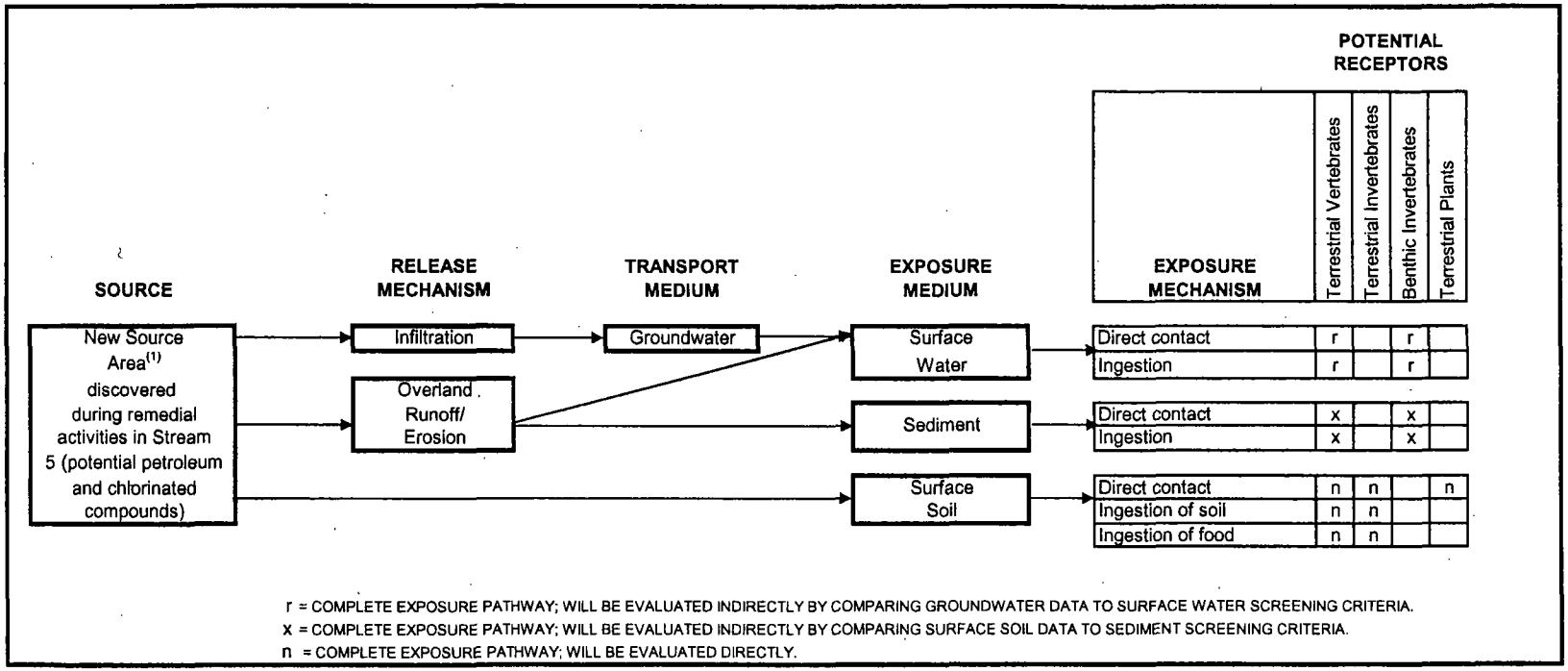
SITES 3 & 7 YEAR 1
GROUNDWATER MONITORING EXCEEDANCES
OPERABLE UNIT 9 -
BASEWIDE GROUNDWATER
NSB-NLON, GROTON, CONNECTICUT

CONTRACT NO.	0894
OWNER NO.	0431
APPROVED BY / DATE	CAL 2/29/08
DRAWING NO.	FIGURE 2-19
REV.	0

FORM CADD NO. TTNUS-BH.DWG - REV 1 - 9/10/98

FIGURE 2-20

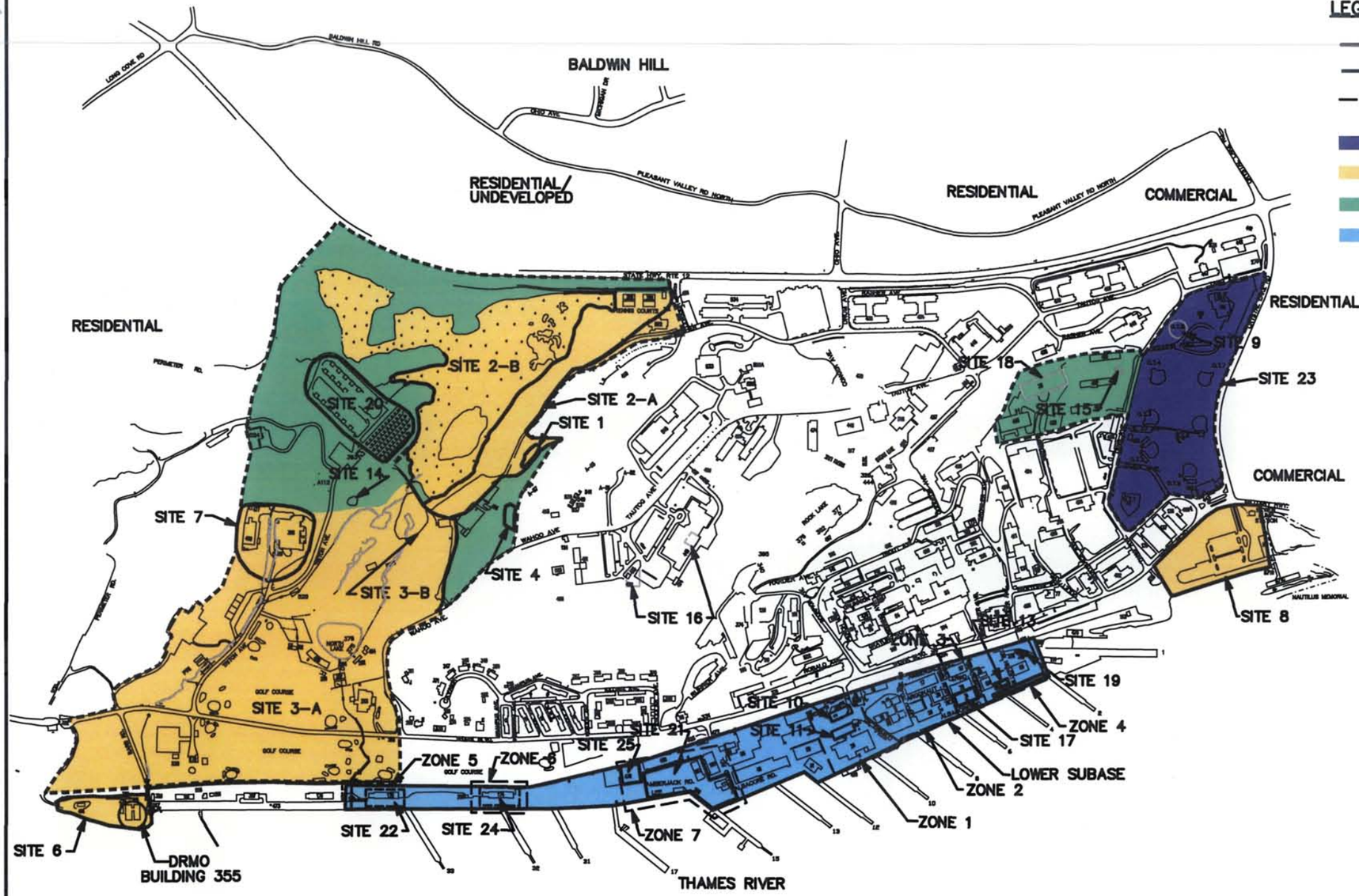
ECOLOGICAL CONCEPTUAL SITE MODEL FOR SITE 3 - NEW SOURCE AREA
OPERABLE UNIT 9 RECORD OF DECISION
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT



Blank space indicates incomplete exposure pathway or relatively insignificant, or not applicable potential exposure.

1 New Source Area located adjacent to Stream 5 in Site 3 - Area A Downstream Watercourses.

ACAD: TTNUS-BH.dwg 08/28/98 INL



LEGEND:

- SITE BOUNDARY
- OU9 BOUNDARY
- LOWER SUBASE REMEDIAL INVESTIGATION ZONE BOUNDARY
- AREA WHERE GROUNDWATER LUCs WILL BE IMPLEMENTED
- AREA WITH GROUNDWATER LUCs
- AREA WITH NO GROUNDWATER LUC
- AREA WHERE GROUNDWATER LUCs ARE TBD IN A FUTURE ROD

LUC LAND USE CONTROL
TBD TO BE DETERMINED
ROD RECORD OF DECISION

SITE 1 – CONSTRUCTION BATTALION UNIT (CBU) DRUM STORAGE AREA
SITE 2 – (A) AREA A LANDFILL AND (B) AREA A WETLAND
SITE 3 – (A) AREA A DOWNSTREAM WATER COURSES AND (B) OVERBANK DISPOSAL AREA (OBDA)
SITE 4 – RUBBLE FILL AREA AT BUNKER A-86
SITE 6 – DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO)
SITE 7 – TORPEDO SHOPS
SITE 8 – GOSS COVE LANDFILL
SITE 9 – OILY WASTEWATER TANK (OT-5)
SITE 10 – LOWER SUBASE-FUEL STORAGE TANKS AND TANK 54-H
SITE 11 – LOWER SUBASE-POWER PLANT OIL TANKS
SITE 13 – LOWER SUBASE-BUILDING 79 WASTE OIL PIT
SITE 14 – OVERBANK DISPOSAL AREA NORTHEAST (OBDANE)
SITE 15 – SPENT ACID STORAGE AND DISPOSAL AREA (SASDA)
SITE 16 – HOSPITAL INCINERATORS
SITE 17 – HAZARDOUS MATERIALS/SOLVENT STORAGE AREA (BUILDING 31)
SITE 18 – SOLVENT STORAGE AREA (BUILDING 33)
SITE 19 – SOLVENT STORAGE AREA (BUILDING 36)
SITE 20 – AREA A WEAPONS CENTER
SITE 21 – BERTH 16
SITE 22 – PIER 33
SITE 23 – FUEL FARM
SITE 24 – CENTRAL PAINT ACCUMULATION AREA (BUILDING 174)
SITE 25 – LOWER SUBASE-CLASSIFIED MATERIALS INCINERATOR

NOTES:

1. SITE BOUNDRIES ARE APPROXIMATE
2. SOPA (ADMIN) NEW LONDON INSTRUCTION 5090.18C (2006) INCLUDES SITE USE RESTRICTIONS FOR AREAS WITH GROUNDWATER LUCs.

0 800 1600
SCALE IN FEET

DRAWN BY CK DATE 7/07/08	Tetra Tech NUS, Inc.	AREAS WITH GROUNDWATER LAND USE CONTROLS OPERABLE UNIT 9 – BASEWIDE GROUNDWATER NSB-NLON, GROTON, CONNECTICUT	CONTRACT NO. 0894
CHECKED BY DATE			OWNER NO. 0431
REVISED BY DATE			APPROVED BY CAR DATE 2/29/08
SCALE AS NOTED			DRAWING NO. FIGURE 2-21 REV. 0

ACAD: 0894CM05.dwg 07/07/08 CK PIT

FORM CADD NO. TTNUS-BH.DWG - REV 1 - 9/10/98

3.0 RESPONSIVENESS SUMMARY

The Responsiveness Summary is a concise and complete summary of significant comments received from the public and includes responses to these comments. In addition, this summary provides decision makers with information about the views of the community. It also documents how the Navy, EPA, and CTDEP considered public comments during the decision-making process and provides answers to significant comments. In accordance with the guidance in Community Relations in Superfund: A Handbook (EPA, 1992), the Responsiveness Summary was prepared after the public comment period, which ended on July 14, 2008.

3.1 OVERVIEW

This ROD is for OU9, Basewide Groundwater, which includes the groundwater at Sites 2A, 2B, 3, 7, 9, 14, 15, 18, 20, and 23. The Proposed Plan, as presented to the public, identified Institutional Controls with Monitoring (Combination of Alternatives GW1-2 and GW2-2) as the Selected Remedy for Sites 3 and 7 groundwater, and Institutional Controls (Alternative GW3-2) as the Selected Remedy for Sites 9 and 23. The Selected Remedies are protective of human health and the environment, attain all ARARs, are considered by the Navy, EPA, and CTDEP as the alternatives that provided the best balance of the evaluation criteria. The Proposed Plan also identified NFA as the Selected Remedy for Sites 2, 14, 15, 18, and 20 groundwater. This remedy is appropriate because there are no unacceptable risks associated with exposure to groundwater at these sites. At Site 2, compliance monitoring of groundwater will continue to be conducted as part of the OU1 remedy.

3.2 BACKGROUND ON COMMUNITY INVOLVEMENT

The public comment period for the Proposed Plan for OU9 began on June 14, 2008, and ended on July 14, 2008. A public meeting was held on June 26, 2008, at the Best Western Olympic Inn on Route 12, Groton, Connecticut, to accept verbal comments on the proposed action. Comments on the proposed remedies were received during the public comment period, but none require revisions to be made to the Selected Remedies, as identified in the Proposed Plan.

3.3 SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND NAVY RESPONSES

Comments received during the June 26, 2008 Public Meeting are summarized below along with the Navy's responses. No other comments were received during the Public Comment Period which ended on July 14, 2008. None of the comments that were received impact the remedies selected by the Navy for

the groundwater in OU9; therefore, no changes to the remedies are required in response to public comments.

Public Comment No. 1 (Mark Oefinger, Groton):

(a) Regarding Site 23, the old tank farm, were the sides and the bottom of the tanks left in place and filled with stone?

(b) The perimeter drains are being used because there is high ground water there, would it have been better to actually remove the drains? Are the perimeter drains needed because there's still contamination in the cement or in the tanks?

(c) Groundwater is being monitored because there is the potential for pollution, or was all pollution previously addressed?

Responses:

(a) Yes. The sides and the bottom of the tanks were left in place and filled with stone.

(b) The ring drains are primarily there because there is a continued need to dewater the site. Dewatering is required because it would flood out what used to be Crystal Lake approximately 50 to 60 years ago and because it may cause some of the tank carcasses to float to the surface. There is no contamination present in the cement of the tanks. All material was removed from the tanks prior to closure.

(c) There is some remnant oil contamination in the soil. The tanks were previously used to store Bunker Fuel (No. 6 Fuel Oil) and No. 2 Heating Oil. The one exception to that was one of the tanks was converted over to storing waste oils (OT-5). Removal actions were previously conducted by the Navy to address a majority of the oil contamination. Residual oil contamination is being addressed through natural attenuation (i.e., the breakdown/degradation of the oil over time). The monitoring provides the means to confirm that the oil is not migrating to the deep drain system which eventually discharges to the storm water system and the Thames River.

Public Comment No. 2 (Felix Prokopf, Ledge Light Health District):

(a) The Ledge Light Health District covers five towns including Ledyard, Town of Groton/City of Groton, Waterford, New London, and East Lyme and there are a lot of board members within

those towns that would appreciate a two- or three-page summary of the Navy's activities. There is too much detail in the current documents for them to review. In addition, board members change every two or three years (e.g., there's new elections for the health district board) and this type of document would be useful for the new members. The document would provide a quick overview of what is going on and where they can get additional information such as at the library. Points-of-contact should also be included in the document. I could hand out this type of brochure if I get calls for information from another town.

(b) I have been coming to these meetings for many years and feel the Navy is doing a terrific job. Previously, the RAB Co-Chairman for the Public had a phone chain that was used to notify all RAB members prior to the meetings. Even after notification, very few officials showed up at the meetings. So there was a good system in place to communicate with members. I do not think the call system is being used anymore. Even though there was little interest in the past, maybe the Navy could improve its community outreach program to see if there is any new interest.

Responses:

(a) The Navy will prepare and provide you with a brief brochure that gives a general snapshot of the entire Installation Restoration Program. The EPA also noted that their website for the base has a two page summary of the progress at all of the sites at Naval Submarine Base - New London. The Navy will include the link to the EPA's website in the brochure.

(b) There was more interest in the environmental program in the past. As the various programs have matured, public interest has faded. As the Navy gets towards the end of the Installation Restoration Program, it is appropriate to reinitiate its community outreach program to make sure that people are aware that the end of the program is coming and things will be closed out soon. The Navy has taken or will take the following steps to improve its community outreach program: (1) The Navy added the Town Managers for the Towns of Groton and Ledyard to its distribution list in addition to the Mayors of those towns, (2) The EPA's Community Outreach Coordinator will be notified to determine if additional efforts are needed to inform the public about the Installation Restoration Program, and (3) the brochure discussed above will be prepared and issued.

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